STATES DEPARTMENT OF THE INTERIOR

FINAL ENVIRONMENTAL STATEMENT

OCS SALE NO. 48 Volume 2 of 5

Proposed
1979 OUTER CONTINENTAL SHELF
OIL AND GAS LEASE SALE
OFFSHORE SOUTHERN CALIFORNIA

Prepared by the
Bureau of Land Management
Frank Gregg
Director

VOLUME 2
TABLE OF CONTENTS

Page

Page

III. ENVIRONMENTAL IMPACT OF THE PROPOSED SALE

A. Basic Assumptions Regarding Causes of Possible Impact Resulting from the Proposed Sale

1. Impacts Resulting from Day-to-Day Operations: As a result of the proposed sale, the development and operational phases of oil and gas producing facilities will discharge materials that may potentially have an impact on the natural environment, the social order, and the economy.

Material that is discharged from offshore oil and gas operations will result from two types of activities: (1) the normal day-to-day activities that may cause chronic effects and (2) the episodic or occasional accidental release events (e.g., an oil spill) resulting from equipment failure, poor operating techniques, or natural phenomena.

The purpose of this section is to describe both the normal day-to-day operations that potentially have long-term effects and the occasional accidental pollution events that can adversely impact the surrounding environment.

Based on the proposed sale estimates, provided by the U.S. Geological Survey Conservation Division (Chapter I, Section ...), the total area of the proposed lease may contain 324 million barrels of oil and 908 billion cubic feet of gas. Basic assumptions concerning these resources and the exploratory and production activities necessary for production can be found in Chapter I (Table I.A.1-2). If the proposed lease sale takes place, exploratory drilling, platform development, and oil and gas production will probably take place over the next 20 years. Tables III.A-1 through III.A-4 have been developed to show the most probable development and resource production estimates for each sale area that may occur until the year 2000. These tables, based on tentative assumptions, are extrapolations of activities that may occur and should not be considered as exact schedules.

With the exception of the Pass Point-San Diego proposed sale area (Table III.A-3), all oil and gas exploratory and development activities for the proposed sale area will be completed and over 90 percent of the oil and gas resources will be depleted by the year 2000. The Pass Point-San Diego sale area oil and gas resources may be 75 percent depleted by the year 2000.

a. Discharge of Drill Cuttings and Drilling Muds: Once drilling starts, drill cuttings and drilling muds will be dumped into the marine environment. Assuming drilling takes place in 1979, 86 exploratory wells and 101 development wells are estimated (U.S. Geological Survey Conservation Division) to be drilled. The purpose of this section is to quantitatively and qualitatively discuss the drill cuttings and drilling muds associated with these wells. The biological impacts and water quality impacts resulting

CHAPTER III

III. ENVIRONMENTAL IMPACT OF THE PROPOSED SALE

A. Basic Assumptions Regarding Causes of Possible Impact Resulting from the Proposed Sale

1. Impacts Resulting from Day-to-Day Operations: As a result of the proposed sale, the development and operation of offshore oil and gas producing facilities will discharge materials that may potentially have an impact on the natural environment, the social order, and the economy.

Material that is discharged from offshore oil and gas operation will result from two types of activities, 1) the normal or routine activities that may occur day-to-day and 2) the episodic or occasional massive emission events (e.g., an oil spill) resulting from equipment failure, poor operation techniques, or a variety of events.

The purpose of this section is to describe both the normal day-to-day operations that potentially have insidious effects and the occasional massive emission events that may acutely impact the surrounding environment.

Based on the proposed sale estimate, provided by the U.S. Geological Survey Conservation Division (Chapter I, Section 1.A.), the total area of the proposed lease may contain 715 million barrels of oil and 860 billion cubic feet of gas. Basic assumptions concerning these unproven resources and the explanatory and operation activities necessary for production can be found in Chapter 1 (Table I.A.2-3). If the proposed lease sale takes place, exploratory drilling, platform development, and oil and gas production will probably take place over the next 40 years. Tables III.A-1 through III.A-6 have been developed to show the most probable development and resource production estimates for each sale area that may occur until the year 2000. These tables, based on tentative assumptions, are extrapolations of activities that may occur and should not be considered as never changing.

With the exception of the Dana Point-San Diego proposed sale area (Table III.A-3), all oil and gas exploratory and development activities for the proposed sale area wil be completed and over 90 percent of the oil and gas resources will be depleted by the year 2000. The Dana Point-San Diego sale area oil and gas resources may be 76 percent depleted by the year 2000.

a. Discharge of Drill Cutting and Drilling Muds: Once drilling starts, drill cuttings and drilling muds will be dumped into the marine environment. Assuming this sale takes place in 1979, 86 exploratory wells and 701 development wells are estimated (U.S. Geological Service Conservation Division) to be drilled. The purpose of this section is to quantitatively and qualitatively discuss the drill cuttings and drilling muds associated with these wells. The biological impacts and water quality impacts resulting

Table III.A-1

Proposed Sale No. 48

Santa Barbara Channel - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilometers of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979	3	1[c]					6,055				2,625		
80	9	4[c]					19,525				8,460		
81	9	6[c]					22,245				9,630		
82	10	14	1		254 (158)		34,690	2,100	2,094		14,990	42,660	2,000
83	7	32	4	2	148 (92)		54,475	8,862	8,865		23,480	24,840	10,000
84	2	47	2	5			67,050	18,228	18,218		28,855		14,000
1985	2	61	1	8			86.090	28,770	28,758	892	37,045		16,000
86	1	57	1	7		1 @ 100MBBL	79,085	33,684	33,679	2,156	34,025		18,000
87	1	39	1	3			54,605	33,096	33,085	2,813	23,495		20,000
88		25		2			34,000	28,350	28,339	3,203	14,625		20,000
89		8		2			10,880	22,554	22,545	3,383	4,680		20,000
1990				1				17,682	17,659	3,536			20,000
91								14,154	14,135	3,765			20,000
92								11,886	11,866	3,697			20,000
93								10,374	10,365	3,766			20,000
94								9,240	9,249	3,918			20,000
1995								8,316	8,306	4,116			20,000
96								7,602	7,608	4,280			20,000
97								6,972	6,980	4,441			20,000
98								6,426	6,422	4,627			20,000
99								6,006	6,003	4,889			20,000
2000								5,586	5,584	5,139			20,000
Totals	44	294	10	30	402 (250)	1 @ 100MBBL	431,950	279,888	279,760	58,621	201,910	67,500	

Table III.A-2

Proposed Sale No. 48

San Pedro - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilo-meters of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979	1					None	1,565				680		
80	1	2[c]					4,285				1,850		
81	1	2[c]					4,285				1,850		
82	2	2	1		103 (64)		5,850	560	444		2,530	17,280	2,000
83	1	8		1			12,445	2,363	1,880		5,360		2,000
84	1	13	1	1			19,245	4,861	3,863		8,285		4,000
1985	1	16	1	2			23,325	7,672	6,098	238	10,040		6,000
86		14		1			19,040	8,982	7,141	575	8,190		6,000
87		12		1			16,320	8,826	7,015	750	7,020		6,000
88		5		1			6,800	7,560	6,009	854	2,925		6,000
89		3					4,080	6,014	4,780	902	1,755		6,000
1990		2					2,720	4,715	3,744	943	1,170		6,000
91								3,774	2,997	1,004			6,000
92								3,170	2,516	986			6,000
93								2,766	2,198	1,004			6,000
94								2,464	1,961	1,045			6,000
1995								2,218	1,761	1,098			6,000
96								2,027	1,613	1,141			6,000
97								1,859	1,480	1,184			6,000
98								1,714	1,362	1,234			6,000
99								1,602	1,273	1,304			6,000
2000								1,490	1,184	1,371			6,000
Totals	8	79	3	7	103 (64)		119,960	74,637	59,319	15,633	51,655	17,280	

Table III.A-3
Proposed Sale No. 48

Dana Point-San Diego - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilo-meters of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979	1						1,565				680		
80	1						1,565				680		
81	2	1[c]					4,490				1,945		
82	2	2	1		24 (15)	1 @ 16000B/d	5,850	175	264		2,530	4,050	2,000
83	2	2		1			5,850	739	1,118		2,530		2,000
84	1	4	1	1			7,005	1,519	2,297		3,020		4,000
1985	1	5		1			8,365	2,398	3,626	74	3,605		4,000
86		5	1				6,800	2,807	4,246	180	2,925		6,000
87		4					5,440	2,758	4,171	234	2,340		6,000
88		1					1,360	2,363	3,573	267	585		6,000
89								1,880	2,842	282			6,000
1990								1,474	2,226	295			6,000
91								1,180	1,782	314			6,000
92								991	1,496	308			6,000
93								865	1,307	314			6,000
94								770	1,166	326			6,000
1995								693	1,047	343			6,000
96								634	959	357			6,000
97								581	880	370			6,000
98								536	810	386			6,000
99								501	757	408			6,000
2000								466	704	429			6,000
Totals	10	24	3	3	24 (15)	1 @ 16000B/d	48,290	23,330	35,271	4,887	20,840	4,050	

Table III.A-4

Proposed Sale No. 48

Santa Rosa - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilo-meters of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979						None							
80	1						1,565				680		
81	1						1,565				680		
82	1	2			97 (60)		4,285	105	162		1,850	16,200	
83		2	1				2,720	443	686		1,170		
84		3		1			4,080	991	1,409		1,755		2,000
1985		3		1			4,080	1,439	2,225	45	1,755		2,000
86		3					4,080	1,684	2,606	108	1,755		2,000
87		2					2,720	1,655	2,560	141	1,170		2,000
88								1,418	2,192	160			2,000
89								1,128	1,744	169			2,000
1990								884	1,366	177			2,000
91								708	1,094	188			2,000
92								594	918	185			2,000
93								519	802	188			2,000
94								462	716	196			2,000
1995								416	643	205			2,000
96								380	589	214			2,000
97								349	540	222			2,000
98								321	497	231			2,000
99								300	464	244			2,000
2000								279	432	257			2,000
Totals	3	15	1	2	97 (60)		25,095	13,995	21,645	2,931	10,815	16,200	

M equals 1,000
MM equals 1,000,000
CF equals cubic feet
ga/day equals gallons per day
BBL equals barrels

[a] Average depth 2.12 km (7,600 feet); depths ranging from 0.61 km to 6.10 km (2,000 to 20,000 feet).
[b] Average depth 1.40 km (4,600 feet); depths ranging from 0.61 km to 4.57 km (2,000 to 15,000 feet).

Table III.A-5

Proposed Sale No. 48

Tanner-Cortes - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilo-meters of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979	1					None	1,565				680		
80	4	4[c]					11,700				5,060		
81	4	6[c]					14,420				6,230		
82	4	13	3[d]		406 (252)		23,940	1,990	2,982		10,325	68,040	2,000
83	3	31	3[d]	1			46,855	8,398	12,624		20,171		4,000
84	1	46	3	3			64,125	17,273	25,943		27,590		10,000
1985	1	58	3	7			80,445	27,263	40,953	845	34,610		16,000
86	1	53	1	6			73,645	31,920	47,961	2,043	31,685		18,000
87		39		6			53,040	31,362	47,116	2,666	22,815		18,000
88		19		4			25,840	26,865	40,356	3,036	11,115		18,000
89		8		1			10,880	21,373	32,106	3,206	4,680		18,000
1990		3					4,080	16,756	25,148	3,351	1,755		18,000
91								13,413	20,129	3,568			18,000
92								11,263	16,898	3,503			18,000
93								9,831	14,761	3,569			18,000
94								8,756	13,171	3,713			18,000
1995								7,880	11,829	3,901			18,000
96								7,204	10,835	4,056			18,000
97								6,607	9,940	4,209			18,000
98								6,089	9,145	4,384			18,000
99								5,691	8,548	4,632			18,000
2000								5,293	7,952	4,870			18,000
Totals	19	279	13	28	406 (252)		410,535	265,227	398,397	55,552	176,716	68,040	

Table III.A-6

Proposed Sale No. 48

Santa Barbara Island - Most Probable Resource Estimates

Year	Exploratory Wells Drilled[a]	Development Wells Drilled[b]	Platforms Placed	Subsea Completions Placed	Kilometers of Pipeline Laid (miles)	Offshore Storage and Treating Facilities	Drill Cuttings BBL's	Oil Produced M BBL/Yr.	Gas Produced MMCF/Yr.	Formation Water M BBL/Yr.	Mud to be Dumped BBL/Yr.	Cu. Yds. of Sediment Disturbance by Pipeline Burial	Platform Sewage ga/day
1979					None								
80	1						1,565				680		
81	1						1,565				680		
82		2		1		1 @ 6000B/d	2,720	70	56		1,170		
83		1	1				1,360	295	236		585		2,000
84		3					4,080	608	486		1,755		2,000
1985		3					4,080	959	767	19	1,755		2,000
86		1					1,360	1,123	898	72	585		2,000
87								1,103	882	94			2,000
88								945	755	107			2,000
89								752	601	113			2,000
1990								589	471	118			2,000
91								472	377	126			2,000
92								396	316	123			2,000
93								346	276	126			2,000
94								308	247	131			2,000
1995								277	221	137			2,000
96								253	203	142			2,000
97								232	186	148			2,000
98								214	171	154			2,000
99								200	160	163			2,000
2000								186	149	171			2,000
Totals	2	10	1	1		1 @ 6000B/d	16,730	9,328	7,458	1,944	7,210		

M equals 1,000
MM equals 1,000,000
CF equals cubic feet
ga/day equals gallons per day
BBL equals barrels

[a]Average depth 2.12 km (7,600 feet); depths ranging from 0.61 km to 6.10 km (2,000 to 20,000 feet).
[b]Average depth 1.40 km (4,600 feet); depths ranging from 0.61 km to 4.57 km (2,000 to 15,000 feet).
[c]Delineation wells
[d]Includes two pipeline connection platforms

from the discharge of drill cuttings and drilling mud are discussed under their respective sections in Chapter III.

Drill cuttings are composed of rock fragments and liquids contained in the geological formation through which the drilling bit is traveling. To remove the drill cuttings, drilling mud (fluid), from the mud system (mud tanks) is circulated down the hole (well) through the drill pipe. Drilling mud is passed out the drilling bit nozzle picking up drill cuttings, and returns to the surface between the drill pipe and walls of the bore hole and/or casing. At the surface, drill cuttings are physically separated from the mud by screening and washing techniques. After the drill cuttings and drilling mud are separated, the drill cuttings are discharged to the ocean and the mud is returned to the mud tank for recirculation down the hole. Drilling mud that is not able to be separated from the drill cuttings is discharged to the ocean. Additionally, mud is discharged to the ocean when excess mud is generated by:

(1) Drilled up solid or water is added to adjust the mud properties
(2) When a completely different mud is needed
(3) Or, at the conclusion of drilling unless mud can be used in a subsequent well (Sheen Technical Subcommittee, 1976)

Removal of drilled cuttings from the hole is only one function of drilling mud. To obtain satisfactory results in the completion of any well, drilling muds have a variety of functions. Drilling mud functions listed by IMCO (1972), are:

(1) Removing the drilled cuttings from the hole
(2) Controlling subsurface pressures
(3) Cool and lubricate the bit and drill pipe
(4) Preventing the walls from caving
(5) To release the drilled cuttings and sands at the well's surface
(6) To prevent damaging effects to the formations penetrated
(7) To allow maximum information from the formations penetrated
(8) To suspend the cuttings and weight material when circulation is stopped
(9) To help suspend the weight of the drill string and casing

To receive maximum benefit from drilling mud at each hole, the mud engineers must change the drilling mud component as new physical information is found out at deeper well hole depths. Discharges of drilling mud must comply with regulations found under OCS Order No. 7 and 40 CFR (Part 435, Section 435,22). Both of these regulations restrict the

discharge of any drilling mud containing oil. Additionally, OCS Order No. 7 forbids the discharge of drilling muds containing toxic substances into the ocean waters. The U.S. Geological Survey, Conservation Division, states if any oil base mud is used, the mud would not be released to the ocean, and cuttings would be cleaned or barged to shore for disposal. Currently, the only mud components used to make up drilling mud, that must be registered with the Environmental Protection Agency, are bacterialcides (Robichaux, 1976).

In drilling, the volume of drill cuttings is dependent on the well depth and the hole size; both dictated by the well casing program. The casing program is dictated by the well depth, which is dependent on the location of known or suspected oil and gas bearing strata. From the casing program shown in Table III.A-7, one finds as deeper well intervals are drilled, the hole size diameter is decreased. Consequently, the volume of drill cuttings per unit length decreases as the hole size decreases with depth. Figure III.A-1 shows the capacity per unit length derived for casings with various inside diameters. The annual drill cutting volume estimated to be discharged from each of the proposed sale areas are shown in Tables III.A-1 through III.A.-5.

Table III.A-7

HOLE SIZE AND CASING PROGRAM

Approximate Interval Drilled[a] Ft.	Hole Size, in.	Casing Size, in.	Volume Interval Drilled[c] Cu. Ft.	Volume Interval Drilled[c] bbl
0-500	36	30	3,534	629
500-1,000	26	20	1,859	331
1,000-3,000	17-1/2	13-3/8	3,369	600
3,000-12,000	12-1/4	9-5/8	7,428	1,322
12,000-15,000	8-3/8	7-5/8[b]	1,157	206
15,000-20,000	6-1/2	5-1/2[b]	1,162	207
		Totals	18,509	3,295

Source: Sheen Technical Subcomittee, 1976.

[a]These depth intervals may be decreased or increased.
[b]Liner.
[c]Does not include washout.

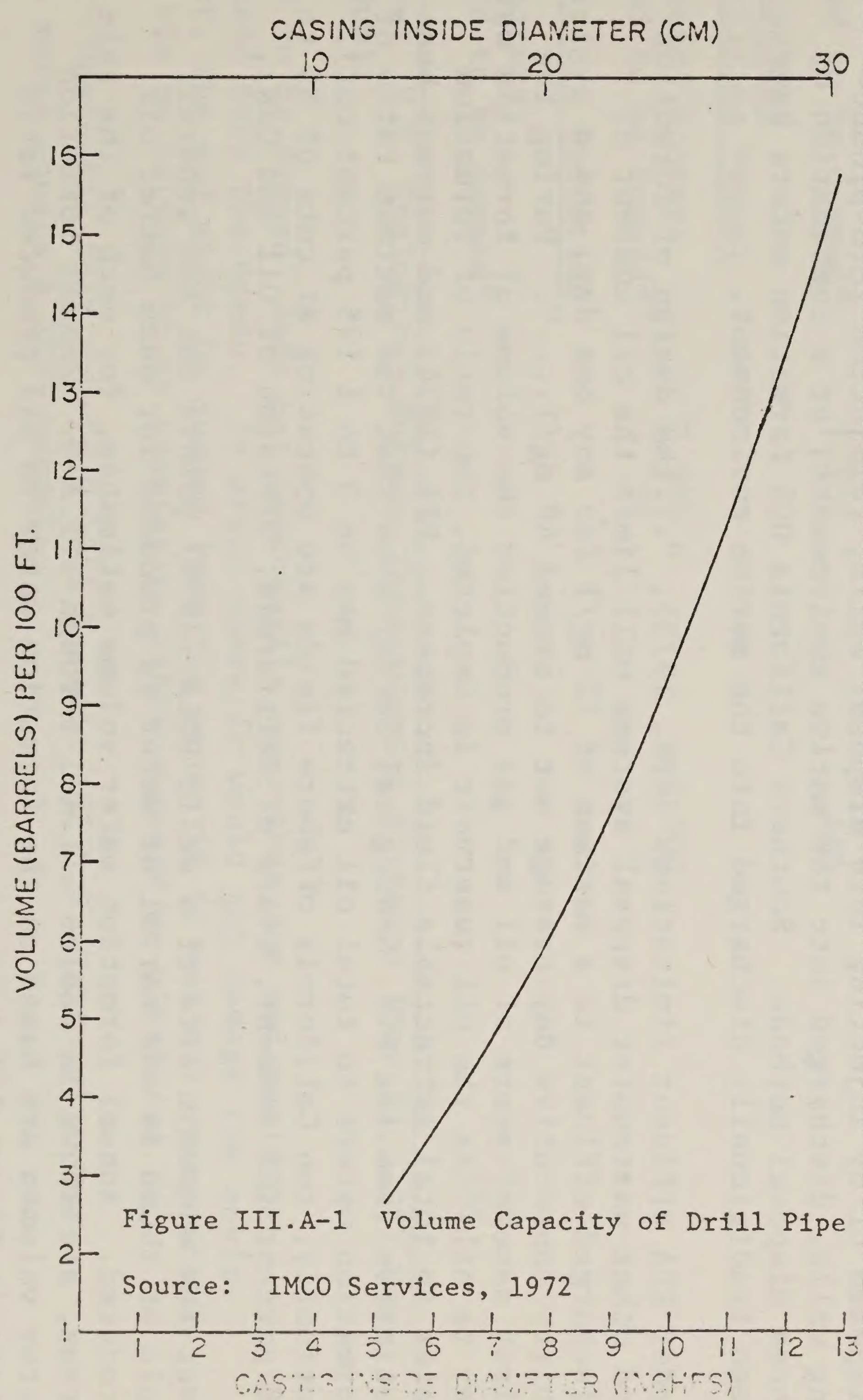


Figure III.A-1 Volume Capacity of Drill Pipe

Source: IMCO Services, 1972

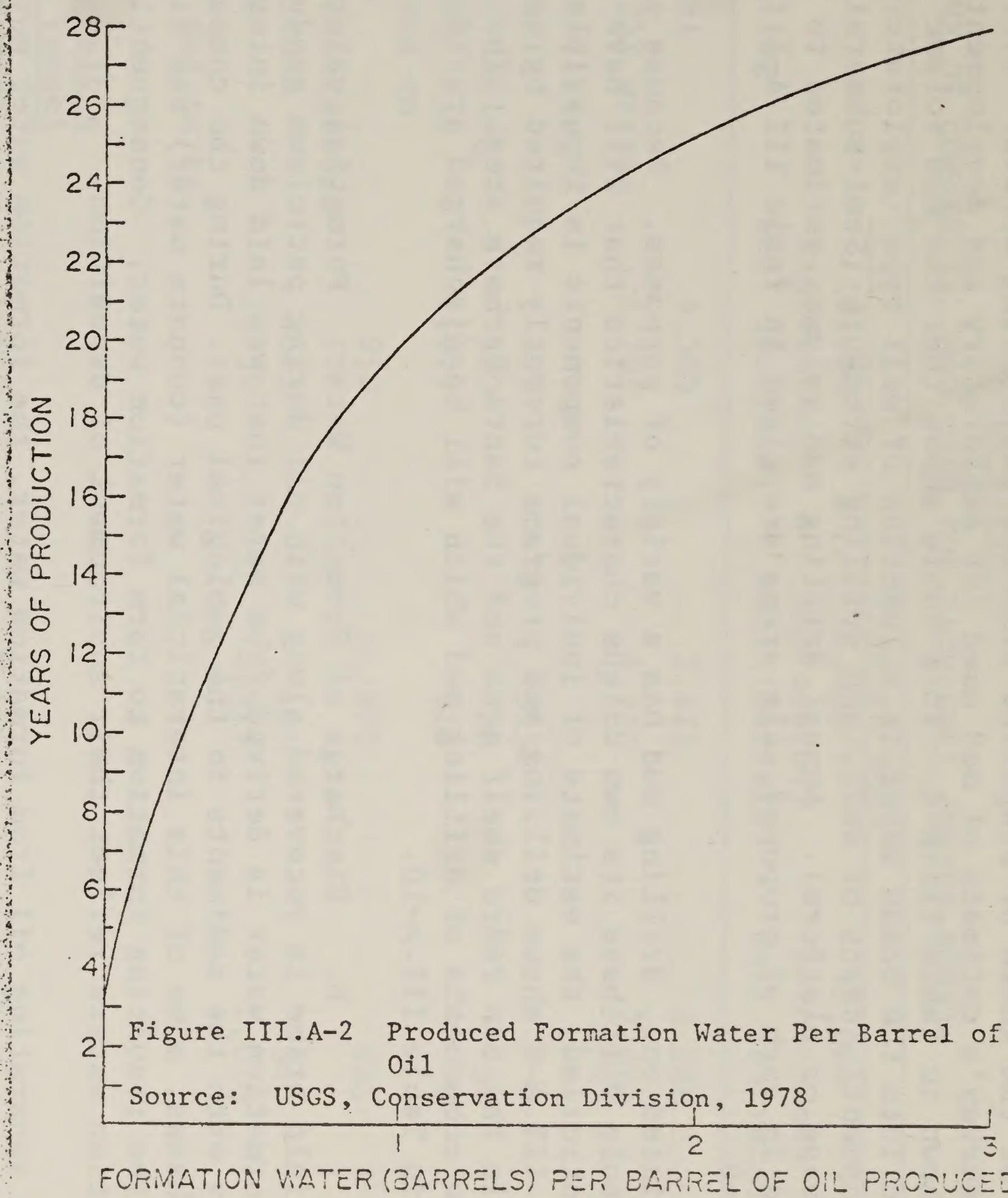


Figure III.A-2 Produced Formation Water Per Barrel of Oil

Source: USGS, Conservation Division, 1978

As with drill cutting volumes, drilling mud volumes are dependent on the depth of the known or suspected oil- and gas-bearing strata. U.S. Geological survey's estimate of mud used for exploratory and development wells are shown in Table III.A-8. This table shows that the mud volume to be dumped into the ocean water is a function of well type (exploratory and development), depth of well, and drilling structure (Semi-submersible, shipshape or platform). Annual drilling mud volumes estimated to be dumped in each of proposed sale areas are given in Table III.A-1 through III.A-6.

As pointed out, drilling mud has a variety of purposes. Because each well hole will have its own unique characteristics that will have to be controlled, the estimate of individual components is impossible. Table III.A-9 shows drilling mud programs currently required by operation in the San Pedro shelf area and the Santa Barbara area. The common components of drilling mud which will be discharged are identified in Table III.A-10.

b. Discharge of Formation Water: Formation water or oil field brine is recovered along with oil during petroleum production. The formation water is derived from water that was laid down interstitially with the sediments in the geological past. During the compaction and phases, some of this interstitial water (connate water) was displaced from the resulting formation to form formation water. Consequently, formation waters reflect their environment of deposition.

After separating oil from formation water, the formation water may be disposed of by injecting into disposal wells, reinjected into producing wells, discharged into the marine environment, or a combination of three disposal methods. Southern California OCS formation waters have been traditionally discharged into the marine environment.

Under EPA effluent limitations (CFR, 1975), "...the design of formation and other wastewater disposal systems will limit the oil content of discharged effluent to a maximum of 72 mg/l for any one day, and a thirty consecutive day average not to exceed 48 mg/l....". During the first several years of oil and gas production the volume of formation water may be nil. As the oil reservoir is depleted, the ratio of formation water to total extractable fluid increases. EPA (1974) and current best estimates from the U.S. Geological Survey show that the maximum ratio of formation waters to total oil extracted may be 3 to 1 (75 percent cut). Currently, two California offshore fields are operating at cuts of 85 to 88 percent (ES comment, State of California, Division of Oil and Gas).

Over the economic life of a well, UCLA (1976) points out the general rule of thumb is one barrel of water is produced for each barrel oil produced. Annual formation water volume estimates, for each of the sale areas, are shown in Tables III.A-1 through III.A-6. Annual formation water volumes are based on the formation water to oil produced ratio given in Figure III.A-2.

Table III.A-8

VOLUME OF COMMERCIAL MUD USED FOR EACH WELL (WATER BORE)

Mud Volume Use in Drilling	Type of Well: 10,000' Exploratory Well (Barrels)	6,000' Exploratory Well (Barrels)	5,000' Development Well (Barrels)
Initial Total	4,565	3,425	2,280
Total plus 25% excess	5,705	4,280	2,850
Mud lost drilling surface hole	395	395	0
Mud behind casing	100	80	55
Mud left in hole	1,095	915	0
Residual mud on cuttings	910	570	445
Mud lost underground to formations	675	405	340
Excess mud	2,530	1,915	2,010
Storage and mud to be dumped			
Semi-submersible Drilling Vessel			
Vessel storage	1,425	1,425	
Mud to be dumped[a]	1,105	485	
Shipshape Drilling Vessel			
Vessel storage	2,500	2,500	
Mud to be dumped[a]	30	0	
Platform Operation			
Storage			1,425
Mud to be dumped[a]			585

Source: U.S. Geological Survey, Conservation Division (May 13, 1977 Memorandum).

[a]"Mud to be dumped" does not necessarily mean that the mud would be released into the ocean. In areas where it would not damage the environment, the mud might be dumped into the ocean if it was not economically feasible to salvage it by tranfer to other vessels or platforms.

NOTE: One cubic foot equals 0.1781 barrels (42 U.S. Gallons). One cubic meter equals 6.2897 barrels.

Table III.A-9

DRILLING MUD TYPES AND RESPECTIVE COMPONENTS OF RECENT (1976 ((LATE)) TO 1978) PRACTICES ON SOUTHERN CALIFORNIA OCS PRACTICES

OCS Area	Mud Type	Components	Lbs/42 Gal. bbl[a]
San Pedro (OCS)			
Depth			
0-800'	Sea water	Sea water	
900-1,600'	Gel/Salt water	Bentonite	20 PPB
		Salt	7
		Lignosulfonate	3
		Caustic Soda	0.5
		Barite	1
1,600-4,600'	Gel/Salt water (treated)	Bentonite	20
		Salt	7
		Lignosulfonate	5
		Caustic Soda	1
		Barite	80
		Los Circulation Material	10
		Drispac (CMC)	1
Dos Quadros (OCS)			
0-350'	Sea water	Sea water	
350-1,200'	Salt Gel	Injection water	(11,000 PPM Cl)
		Attapulgite Clay	10-12 PPB
		Caustic Soda	>0.5 PPB
		Bicarb	>0.5 PPB
1,200-3,000'±	Gel water	Injection water	
		Bentonite	10+ PPB
		Drispac	1 PPB
		Caustic Soda	>0.5 PPB
		XMDL (Surfactant)	1-2 PPB

Table III.A-9 (Cont.)

OCS Area	Mud Type	Components	Lbs/42 Gal. bbl[a]
Completion Phase	Brine/Polymer	Potassium Chloride	60 PPB
		Hydroxy Ethyl Cellulose	2 PPB
		Caustic Soda	0.5 PPB
		Sodium Carbamate (Biocide)	0.5 PPB
Oakridge (OCS)			
0-200'±	Sea water	Sea water	
200-400'	Gel/Water	Bentonite	25 PPB
		Lignosulfonate	2 PPB
		Caustic Soda	>0.25 PPB
		Soda Ash	>0.5 PPB
400-3,500'	Gel/Water (treated)	Bentonite	20 PPB
		Lignosulfonate	4 PPB
		Caustic Soda	1 PPB
		Soda Ash	>1 PPB
		Barite	60 PPB
3,500-5,000'	Gel/Water (treated)	Same as above	
		+ Barite	65+ PPB
5,000-8,000'	Gel/Water (treated)	Same as above	
		+ Barite	100-120 PPB
		+ Poly Rx	1-2 PPB
		+ Defoamer	-
		+ Lost Circulation Material	5-10 PPB
8,000'	Perforating Fluid	Calcium Chloride	110-120 PPB
5,000-8,000'	Minimum Solids Non-Dispersed	Same as above	
		+ Barite	180-200 PPB

Source: (Lloyd, 1978).

[a]One pound per barrel. Metric equivalent is 2,449 mg/l.

Table III.A-10

MATERIALS AND THEIR USE IN DRILLING MUDS

Material	Usual Purpose
Gelling and Suspending Agents	
Bentonite (Sodium montmorillonite clay)	Provide gel properties
Attapulgite (a clay mineral)	Provide gel properties in very high salinity fluids and to overcome loss of circulation
Acrylic polymers	Increase thickening properties of bentonite
Thinners and Filtration Control Agents	
Chrome lignosulfonates	Thinner (deflocculant) and filtration control agent
Lignites	Thinner and filtration control agent, usually at high temperatures (>300°F)
Tannins including quebracho	Thinner for fresh water muds at lower temperatures (>250°F)
Sodium acid pyrophosphate (SAPP) and other complex phosphates	Thinner (deflocculant for fresh water muds at lower temperatures (>250°F), treatment for cement or anhydrite contamination
Pregelantinzed starch	Filtration control
Density Control Agent	
Barite ($BaSO_4$)	Increase mud density
pH and Other Ion Control Agents	
Caustic soda (sodium hydroxide)	pH control
Soda ash (sodium carbonate)	Remove Ca++ (anhydrite) contamination by precipitating $CaCo_3$
Sodium bicarbonate	Treatment for cement contamination
Lime	pH control and Ca++ control
Sodium chromate	Improve high temperature (>300°F) thinning action of lignosulfonates and lignites
Sodium chloride	Salinity control in very special purpose muds
Calcium chloride	Salinity control in very special purpose muds

Table III.A-10 (Cont.)

Material	Usual Purpose
Organic Specialties	
Surfactants	Improve flow properties
Defoamers	Improve flow properties, minimize density variations
Bactericides	Protect organic additives from microbial decomposition
Corrosion inhibitors	Protect metal parts

Source: Adapted from Gray, 1970.

Dissolved elements and their respective concentrations will depend upon which formation the oil field is in contact with. Some fields in Texas produce almost pure water, whereas in Michigan field produced brines containing 624 parts per thousand (ppt) mineral salt. Based on a small amount of data, the oil field brines (formation waters) of the California coastal region, range from 22 ppt to 40 ppt mineral salts. The most common chemical constituents found in formation waters are iron, calcium, magnesium sodiums, bicarbonate, sulphates and chloride. In addition to the chemical constituents, formation waters contain entrained oil or petroleum hydrocarbons, numerous trace elements, and an absence of dissolved oxygen. Table III.A-11 shows the concentration of chemical and physical parameters that were found in the wastewater of Phillips Petroleum Company, La Conchita Plant. The chemical constituent concentrations found in formation waters along the California coast, are shown in Table III.A-12.

Both the 16-year mean annual and total mass emission rate to the year 2000 for each sale are shown in Table III.A-13. The values shown in Table III.A-13 were based on formation water annual emission rates shown in Tables III.A-1 through III.A-6 and formation water constituents values shown in Table III.A-12. See Appendix J for more details.

c. Disposal of Solid Waste and Sewage: The disposal of solid waste into the offshore waters is regulated through OCS Order No. 7 and Title 40 Code of Federal Regulation (Part 435, Subpart B 435.22). OCS Order No. 7 restricts the disposal of solids containing oil. Additionally, mud containers and other solid waste shall be transported to shore for disposal. The Code of Federal Regulations specifies that there shall be no floating solids as a result of discharge of domestic wastes.

Table III.A-11

TYPICAL CHARACTERISTICS OF EFFLUENT FROM WATER TREATMENT FACILITIES
Phillips Petroleum Company
OCS P-0166 Lease - La Conchita Plant

Physical Properties		Chemical Properties, mg/l	
pH	7.3	Aluminum	2.2
Specific Gravity	1.02	Ammonia, N	39.7
Turbidity	12 JTU	Arsenic	0.001
Total Dissolved Solids (Calc.)	40,400 mg/l	Barium	0.
Total Solids	20,990 mg/l	Bromide	183.8
Total Volatile Solids	1810 mg/l	Cadmium	0.030
Total Suspended Solids	56 mg/l	Chromium	0.020
Settlable Solids	0.1 mg/l	Copper	0.116
Floatable Solids	0.3 mg/l	Cyanide	o.004
Temperature	77°F	Fluoride	1.7
BOD, 5-day	450 mg/l	Iron	1.35
COD	691 mg/l	Lead	0.28
Specific Conductance	31,630 m-mhos/cm		
Max. $CaSO_4$ Possible (Calc.)	0. mg/l	Magnesium	50.0
Max. $BaSO_4$ Possible (Calc.)	0. mg/l	Manganese	0.062
Alkalinity as $CaCO_3$	3480 mg/l	Mercury	0.0005
		Nickel	0.29
Dissolved Solids		Nitrate, N	0.0
Cations		Nitrate, N	0.000
Total Hardness	10 me/l	Kjeldahl Nitrogene	54.6
Sodium, Na+ (Calc.)	15,000 mg/l	Phosphorus-Ortho, P	1.54
Calcium, Ca+ +	80 mg/l	Phosphorus, P	1.89
Magnesium, Mg+ +	72 mg/l	Silver	0.030
Iron (Total), Fe+++	1.0 mg/l	Zinc	0.18
Anions		Phenolic Compounds C6115011	2.10
Chloride, Cl-	21,000 mg/l	Identifiable Chlorinated Hydrocarbons	None
Sulfate, SO -	0. mg/l		
Carbonate, CO_3	0. mg/l	Radioactivity	

Table III.A-11 (Cont.)

Physical Properties		Chemical Properties, mg/1	
Bicarbonate, HCO_3-	4,270 mg/1	Gross Alpha Activity	None Detected
Hydroxyl, OH-	0. mg/1	Gross Beta Activity	None Detected
Sulfide, S-	1.1 mg/1	Oil and Grease	5.0
Dissolved Gases			
h_2S	0.4 mg/1		
CO_2	320 mg/1		
O_2	0.3 mg/1		

The estimated annual discharge of sewage from platforms, which may be placed in the proposed development areas, are shown in Tables III.A-1 through III.A-6. OCS Order No. 8 states "following sewage treatment, the effluent shall contain 50 ppm, or less, of suspended solids, and shall have a minimum chlorine residual of 1.0 mg/liter after a minimum retention time of 15 minutes.

Table III.A-12

CALIFORNIA OFFSHORE PRODUCED FORMATION WATER
Constituents Range[a]

Formation Water Constituent	Concentration (mg/l)
Salinity	
(Total dissolved solids)	21,700 - 40,400
Suspended solids/turbidity	
(Untreated water)	30 - 75
Oxygen Demand	
BOD (5-day)	370 - 1,920
COD	340 - 3,000
Oil and Grease	56 - 359
Trace Contaminants	
[a]Arsenic	0.001 - 0.08
Cadmim	0.02 - 0.18
Total Chromium	0.02 - 0.04
Copper	0.05 - 0.116
Lead	0.0 - 0.28
Mercury	0.0005- 0.002
Nickel	0.100 - 0.29
Silver	0.03 -
Zinc	0.05 - 3.2
Cyanide	0.0 - 0.004
Phenolic Compounds	0.35 - 2.10

Source: (EPA, 1974).

[a]Same data reflect treated waters for reinjection.

NOTE: Due to the limited data from California offshore wells, these values represent estimated constituent values.

Table III.A-13

PROPOSED SALE NO. 48 MEAN-ANNUAL[a] AND TOTAL MASS EMISSION RATES IN METRIC TONS TO THE YEAR 2000[b]

Area	Flow 10^3 BBL	Turbidity Suspended Solids	Oxygen Demand BOD	BOD	Oil and Grease	Trace Contaminants: Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Cyanide	Phenolic Compounds
Santa	3,663/yr.	17-44	2.15-	198-	33-44	0.003-	0.01-	0.01-	0.03-	0-0.16	0.0003-	0.058-	0.17	0.03	0-	0.20-1.2
Barbara	(mean)		1117	1746		0.05	0.10	0.02	0.07		0.001	0.17		0.19	0.002	
Channel	58,621	280-699	3437	3167	522-	0.009-	0.19-	0.19-	0.47	0-2.6	0.0005	0.93-	0.28	0.47	0-0.04	3.3-20
	(total)		-17884	27944	699	0.75	1.67	0.58	1.09		0.02	2.7				
San	977/yr.	4.65-12	57-298	52-	9-12	0.0002-	0.003-	0.003-	0.008-	0-0.04	0.0001-	0.016-	0.005	0.008	0-	0.5-0.33
Pedro	(mean)			466		0.01	0.03	0.006	0.018		0.0004	0.05		0.5	0.001	
	15,633	75-186	919-	844-	139-	0.002-	0.05-	0.05-	0.12-	0-0.69	0.001-	0.25-	0.07	0.12-	0-0.01	0.87-5.2
	(total)		4769	7452	186	0.20	0.44	0.1	0.28		0.004	0.72		7.9		
Dana	305/yr.	1.95-3.64	18-93	16-	2.71-4	<0.0001	0.001-	0.001-	0.002-	0-0.01	<0.0001-	0.005-	0.001-	0.002	0-	0.02-0.10
Point-	(mean)			145		-0.004	0.01	0.002	0.005		0.0001	0.014		-0.16	0.0002	
San	4887	23-58	287-	264-	44-58	0.001-	0.016-	0.016-	0.04-	0-0.22	0.0004-	0.08-	0.02-	0.04-	0-0.003	0.32-1.6
Diego	(total)		558	2329		0.06	0.	0.032	0.09		0.0016	0.23		2.5		
Santa	183/74.	0.87-2.18	11-20	10-87	1.6-	<0.0001	0.001-	0.001-	0.001-	0-0.01	<0.0001-	0.003-	0.0009	0.001	0-	0.01-0.06
Rosa	(mean)				2.2	-0.002	0.14	0.002	0.002		0.0001	0.008		0.09	0.0002	
	2931	14-35	176-	158-	26-35	0.0005-	0.01-	0.001-	0.02-	0-0.13	0.0002-	0.05-	0.01	0.002	0-0.002	0.16-0.01
	(total)		320	1397		0.04	2.2	0.002	0.05		0.0008	0.14		1.5		
Tanner-	3472/yr.	17-41	208-	137-	31-41	0.0006	0.01-	0.001-	0.02-	0-0.15	0.0002-	0.06-	0.1	0.02-	0-0.002	0.19-0.01
Cortes	(mean)		379	1654		-0.05	2.6	0.002	0.05		0.001	0.17		1.8		
	55,552	265-663	3335-	2295-	493-	0.01-	0.19-42	0.002-	0.88-	0-2.46	0.004-	0.95-	0.19	0.38-	0-0.03	3.03-0.19
	(total)		6065	26464	663	0.76		0.04	0.38		0.02			28		
Santa	212/yr.	0.58-1.4	7.3-13	6.5-	1.1-	0.0002	0.0004	<0.0001-	0.001-	0-0.005	<0.0001	0.002-	0.0004	0.001	0-	0.01-
Barbara	(mean)				1.4	-0.002	0.1	0.0001	0.002			2.65		-0.06	0.0001	0.0004
Island	1944	9.3-23	117-	104-	17-23	0.0003-	0.007-	0.0001-	0.01-	0-0.09	0.0001	0.03-	0.007	0.99	0-0.001	0.11-0.007
	(total)		212	926		0.03	1.46	0.001	0.02		-0.0005	43				

[a]These values were based on flow rates found in Tables III.A-1 through III.A-6 and chemical values found in Table III.A-10. Mass emission rates during the initial year of formation water production should be approximately 40% less than mean values in this table. By the year 2000, the mass emission rates should be approximately 40% greater than the mean values given in this table.

[b]The emission value range reflects the range of constituent concentrations shown in Table III.A-10.

2. Impacts Resulting from Pipeline Burial: During pipeline burial, the sea bottom would be disturbed by trenching and anchor laying. The trenching would cause a disturbance at the sea bottom and a temporary water turbidity. Anchor laying would cause disturbance at the sea bottom.

Based on available information, pipeline burial in certain specified areas in or near the proposed lease sale area may be required by the Corps of Engineers (COE) and the Department of Transportation (DOT). The COE requires that a pipeline be buried at a minimum of 1.5 m (5 feet) below the channel bottom when crossing a COE designated channel. The DOT, in "Title 49 Code of Federal Regulation, Subpart A, Transportation of Liquid by Pipeline", requires that all DOT responsible submerged pipelines in water depth of less than 3.7 m (12 feet) must be covered by 0.9 m (3 feet) for normal excavation. DOT also requires that pipelines in water depth between 3.7 to 61 m (12 to 200 feet) must be buried below the natural bottom unless the pipe is supported or protected by other means such as concrete coating. These pipeline burial requirements could apply to the assumed four pipelines for the proposed lease sale area. These pipelines are: Santa Barbara Channel to Ventura; Santa Rosa and Tanner-Cortes to Ventura; San Pedro Bay to Los Angeles-Long Beach Area; and Dana Point-San Diego Area to San Diego.

A local fisherman indicated that trawling is conducted only in the Santa Barbara Channel and in water depth to 274 m (900 feet). They also indicate that unburied pipelines having a smooth surface with protective covering for any projection such as anodes and valves would not present any fishing problem (Frank Donahue, Santa Barbara Trawler, personal communication).

Offshore pipelines would be buried by dredging onshore and nearshore and by jetting in deeper water. Also, development work is being conducted on underwater plowing which cuts pipeline trenches. Underwater plowing was successfully conducted in the Stratford field area for Mobil. Dredging would be conducted by a clamshell type dredger which normally operates in water depth to 15 m (50 feet) and can operate in 61 m (200 feet). The dredger could be an integral part of a barge or could be transported by road to the construction site. A loading pier may be required to load the dredger on the barge. The barge is held in position by a set of 4 to 6 anchors which are moved approximately every 305 to 457 m (1,000 to 1,500 feet) of trenching. The clamshell dredger would disturb and resuspend the bottom material as the "bucket" bites into the sediment and breaks free when hoisted. When pipeline burial is required, the sediment would be placed next to the trench. After the pipeline is laid, the dredger would cover the piping.

For deep water, the pipeline would be buried by a submerged jet-sled which would be towed by a barge along the path of previously laid

Table III.A.2-1

PIPELINE BURIAL

Pipeline Routing	Jet Sled			Clamshell Dredging		
	Length Kilometers (Miles)	Excavation cubic meter (Cubic feet)	Number of anchor position changes	Length Kilometers (Miles)	Excavation cubic meter (Cubic feet)	Number of anchor position changes
Santa Barbara Channel to Ventura	16.1 (9.5)	3.7×10^4 (1.31×10^6)	13	0.8 (0.5)	0.4×10^4 (0.14×10^6)	3
Santa Rosa and Tanner-Cortes to Ventura	16.1 (9.5)	3.7×10^4 (1.31×10^6)	13	0.8 (0.5)	0.4×10^4 (0.14×10^6)	3
San Pedro Bay to Los Angeles-Long Beach Area	15.2 (9.0)	2.2×10^4 (0.77×10^6)	12	5.9 (3.5)	1.5×10^4 (0.53×10^6)	18
Dana Point-San Diego Area to San Diego	11.8 (7.0)	0.8×10^4 (0.30×10^6)	9	5.1 (3.0)	0.9×10^4 (0.33×10^6)	16

pipeline. The sled straddles the pipe and digs into the sea bottom on either side of the pipe as it is pulled along by a towline from the surface barge. The water jets from the trencher cut and emulsify the ocean floor material. Loose mud and sand are then carried up through the pipes for side disposal. The pipe then settles into the trench and is eventually buried by mud and sand. The barge is held in position by 8 anchors and chains. These anchors would be moved approximately every 1,219 m (4,000 feet) of trenching.

Generally, the ocean floor from 61 m (200 feet) in water depth to shore for the above four pipeline routings is mud and sand. These pipelines may be buried to water depth of 61 m (200 feet) and must be buried in water depth of not less than 3.7 m (12 feet) and when crossing a Corps of Engineers designated channel.

Table III.A.2-1 illustrates the estimated pipeline trenching for the four assumed pipeline routings. The trenching with jet-sled includes pipeline route from water depth of 61 m (200 feet) to approximately 3.7 m (12 feet). A cross section for the jet-sled trenching is an assumed rectangle of approximately 1.2 m (4 feet) deep by 1.2 to 2.1 m (4 to 7 feet) wide. Trenching with clamshell dredger includes pipeline route from water depth of approximately 3.7 m (12 feet) to shore. A cross section for clamshell trenching is an assumed isosceles trapezoid of 1.2 to 1.8 m (4 to 6 feet) deep by 1.2 to 2.1 m (4 to 7 feet) wide at the bottom with sloping side of 2:1. These depth and width variations for the trenching depend on the number of pipelines and their diameters.

In conclusion, the pipeline burial operation could bury about 68 km (42-45 miles) of pipelines, excavate approximately 137,000 cubic meters (179,000 cubic yards) of sea bottom, and have nearly 87 anchor position changes.

3. Impacts Resulting from Emplacement of Structures: The impacts resulting from emplacement of structures include the oil and gas offshore activities, well drillings, pipeline laying, platform construction, offshore storage and loading facility installation, subsea completion system installation, and the supporting onshore facility activities. Tankering is described in Section III.A.4.iii. These oil and gas activities could disrupt the seabed, interfere with fishing, impact navigation, and disrupt normal onshore activities. Figure III.A.3-1 illustrates the proposed offshore pipelines and the established and non-established shipping lanes. (Appendix F, Proximity Analysis, summarizes impacts from structural development.)

Table III.A.3-1 summarizes the causes of possible impact on the Southern California Bight area resulting from emplacement of structures. The emplacement of structures could not impact the Baja California area but could cause a minor impact on the tankering leg around Point Conception to Point Reyes. Barging of platform components from north of Point Conception could interfere with above tankering, temporarily.

In addition to Sale No. 48, Section I.E identifies 12 projects and proposals that could result in cumulative impacts to Sale No. 48. For this section the following two projects could have a cumulative impact: Existing Federal leases in the Santa Barbara Channel and OCS Sale No. 35 leases. Development of both projects could occur during the period 1979 to 1984 and could have the following structures: Existing Federal leases in Santa Barbara Channel, 18 platforms and 146 km (91 miles) of pipeline; OCS Sale No. 35 leases, 38 platforms and 582 km (362 miles) of pipeline. For the same period, the proposed Sale No. 48 could have 22 platforms and 681 km (423 miles) of pipeline. In comparison, the proposed Sale No. 48 development could be between 28 to 48 percent of the total cumulative development activities.

a. Drilling Rigs, Boats and Pipe-Lay Barges: A drillship would disturb the sea floor with emplacement of anchors and drilling of wells. The pipe-lay barges would also disturb the sea floor with emplacement of anchors and laying of pipelines. The drillships, pipe-lay barges, crew boats and supply boats could impact navigation, especially when the drillships and pipe-lay barges are operating in the sea lanes and when the crew and supply boats are crossing the sea lanes. When the drillships and pipe-lay barges are operating in the Santa Barbara Channel in water depth of less than 274 m (900 feet), the anchors and chain emplacement could interfere with trawl fishing.

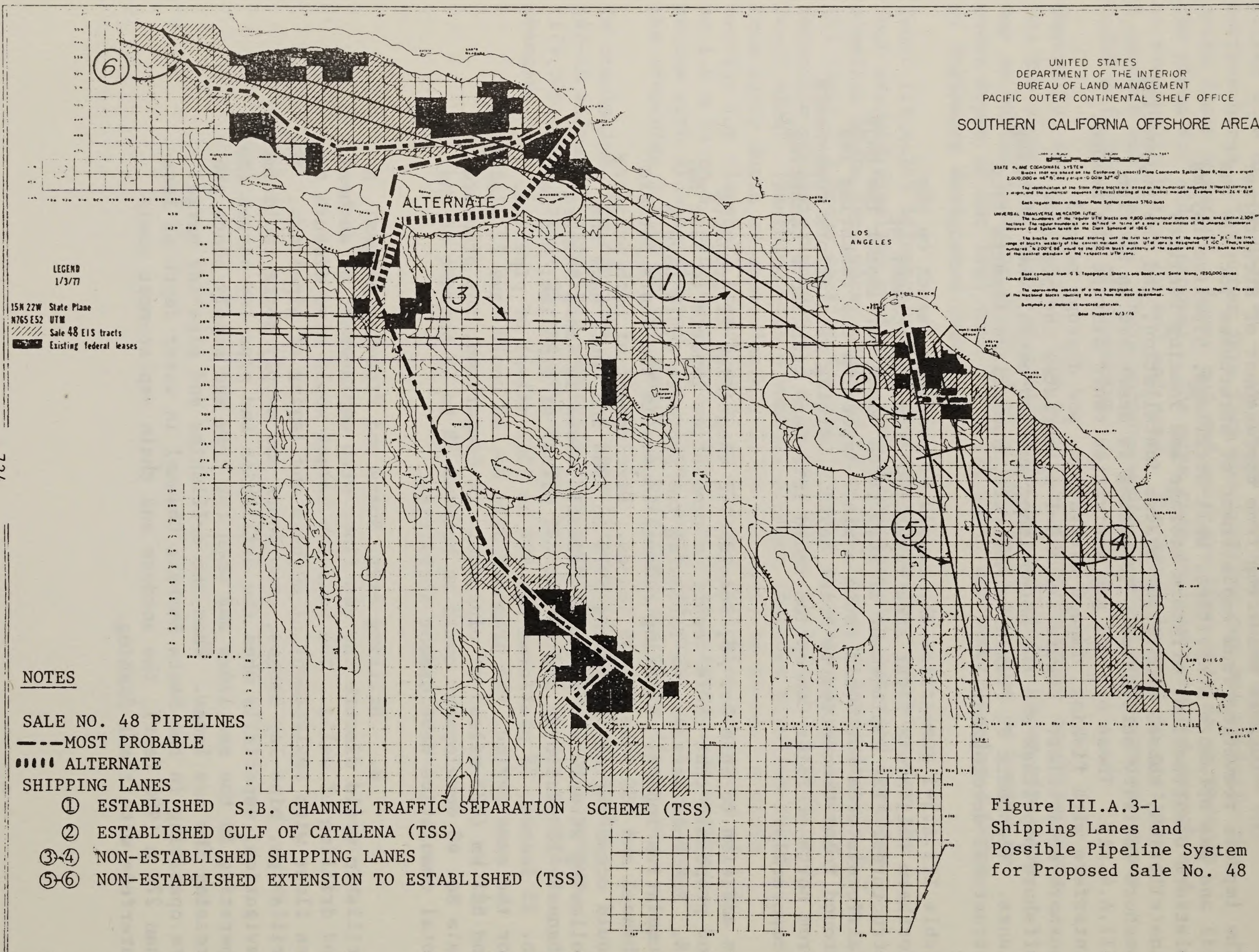


Figure III.A.3-1
Shipping Lanes and
Possible Pipeline System
for Proposed Sale No. 48

Table III.A.3-1

POSSIBLE CAUSE OF ENVIRONMENTAL IMPACT BY EMPLACEMENT OF STRUCTURES IN THE SOUTHERN CALIFORNIA BIGHT AREA

Southern California Bight Area	Sea Floor Disturbance(a)	Navigation Interference in the Shipping Lanes(b)	Trawl Fishing Interference(c)
Santa Barbara Channel	44 exploratory wells 30 subsea completion systems 10 platforms(d) 1 offshore storage & treating facility 306 km (190 miles) of pipelines	Crew and supply boats from Port Hueneme to cross shipping lane in the Santa Barbara Channel Traffic Separation Scheme (TSS). Pipe-lay bridges 13 days in TSS. Barges for platform components to cross one or more shipping lanes	Yes
San Pedro Bay	8 exploratory wells 7 subsea completion systems 3 platforms 51 km (32 miles) of pipelines	Crew and supply boats from Los Angeles - Long Beach Port to cross shipping lane in the Gulf of Santa Catalina TSS. Pipe-lay barges 5 days in TSS and 7 days in precautionary area. Barges for platform components to cross one or more shipping lanes.	No
Dana Point - San Diego	10 exploratory wells 3 subsea completion systems 3 platforms 1 offshore storage and treating facility 24 km (15 miles) of pipelines	Crew and supply boats from Los Angeles - Long Beach Port to cross Gulf of Catalina TSS and from San Diego Port to cross San Diego to Los Angeles-Long Beach Port shipping lane. Barges for platform components to cross one or more shipping lanes	No

Table III.A.3-1 (Cont.)

Santa Rosa Islands	3 exploratory wells 2 subsea completion systems 1 platform	Crew and supply boats from Port Hueneme to cross the Santa Barbara Channel TSS and the shipping lane from Los Angeles-Long Beach Port to the Orient via Santa Rosa Island. Barges for the platform components to cross one or more shipping lanes.	No
Tanner - Cortes Bank	19 exploratory wells 28 subsea completion systems 13 platforms(d) 299 km (186 miles) of pipelines	Crew and supply boats from Port Hueneme to cross both Santa Barbara Channel TSS and shipping lane to the Orient via Santa Rosa Island. Pipelay barges 5 days in each of the two shipping lanes described above.	No
Santa Barbara Islands	2 exploratory wells 1 subsea completion system 1 platform 1 offshore storage and treating facility	Crew and supply boats from Los Angeles-Long Beach Port to cross Gulf of Catalina TSS and shipping lane to the Orient via Santa Rosa Island. Barges for platform components to cross one or more shipping lanes.	No

Notes:

(a) Drillship could lay the 8 anchors and chains for each exploratory well and subsea completion system. Pipe-lay barge could lay the 8 anchors and chains for every 1-6 km (one mile) of laid pipelines. The well drillings, pipe laying, platform construction, subsea completion system installation, construction of SALM for the offshore storage and treating facility, and emplacement of anchors and chains could disturb the sea floor.

(b) Four existing shipping lanes in the Southern California Bight area are: Santa Barbara Channel Traffic Separation Scheme (TSS), Gulf of Santa Catalina TSS, shipping lane from the Los Angeles-Long Beach Port to the Orient via Santa Rosa Island, and shipping lane between San Diego and Los Angeles-Long Beach Port.

(c) Trawl fishing is conducted only in the Santa Barbara Channel and in water depths of less than 274 m (900 feet). Any structures in water depths less than 274 m (900 feet) could interfere with trawl fishing.

(d) Included pipeline connection platforms in combination with Sale No. 35 leases (3 Santa Barbara Channel, 4 Tanner-Cortes).

A mooring type of drillship would place 8 anchors and start the well drilling. The anchors could be placed at an approximate distance of 3 to 8 times the water depth of the well. Some anchors could be placed as far as 1,609 m (1 mile) from the drillship. These anchors and chains would disturb the sea floor during emplacement and removal.

The exploratory well drilling in the proposed tracts is expected to start in 1979, ending in 1988. An estimate of 86 wells could be drilled. At each of a cluster of these wells, the anchors from the drillship could be placed and recovered. Maximum number of well drillings per year is expected to occur during 1982 when 6 drillships could drill a total of 36 wells. Each drillship would need servicing from the crew and supply boats.

There are 8 proposed tracts which are either partially or totally within the Gulf of Santa Catalina Traffic Separation Scheme. The U.S. Corps of Engineers' proposed guidelines for "Permit for Exploratory Drilling in the Gulf of Santa Catalina Traffic Separation Scheme" was published in the Federal Register, June 7, 1977. These guidelines would reduce any navigation hazard when the well drilling operation occurs in or near the traffic lanes. Also, there are approximately 42 proposed tracts which are either partially or totally within the Santa Barbara Channel Traffic Separation Scheme. According to the Corps of Engineers, there is no well drilling guideline for the latter separation scheme. However, the Crops of Engineers and the Coast Guard have established a policy of permitting no structures or drilling vessels in the traffic lanes.

The pipe-lay barge would place 8 anchors and start laying a pipeline on the ocean floor. Anchor emplacement has been previously described for the drillship. As an estimate, the anchors for the lay barge would be moved for every 1.6 km (1 mile) of laid pipeline. Two anchors could be placed on each side of the lay barge as far out from the barge as 1.6 km (1 mile). These 8 anchors would be temporarily placed and would disturb the sea floor. The pipelines would be laid on the sea floor for the duration of petroleum production and could be abandoned or removed. These pipelines would disturb the sea floor but would provide an artificial reef for marine life.

For the proposed tracts, an estimate of 681 km (423 miles) of pipeline could be installed. In 1982, 2 pipe-lay barges could install 624 km (388 miles) of pipeline. The remaining 57 km (35 miles) could be installed in 1983. These pipelines could disturb a total of 52 ha (128 acres) of sea floor. The anchors and chains from the lay barges would also disturb the sea bottom continuously along the 681 km (423 miles) of pipeline.

Each pipe-lay barge would need servicing from a crew and supply boats. The lay barges, crew and supply boats could temporarily impact navigation, especially when crossing the traffic lanes. Based on traveling about 1 mile per day, the barge could be within the traffic lanes and separation zone in Santa Barbara Channel for about 13 days for the pipelines laid from Santa Barbara Channel to Ventura; and about 5 days for laying the pipelines from Tanner-Cortes to Ventura. The lay barge for the San Pedro Bay to Los Angeles-Long Beach Port pipeline could be within the Gulf of Santa Catalina traffic lanes and separation zone for about 5 days; and within the precautionary area for about 7 days.

Crew and supply boats would continuously service the drillships and pipe-lay barges. These boats could cause navigation hazards when crossing the shipping lanes. There are four shipping lanes in the Southern California Bight area, and these are: Established Santa Barbara Channel Traffic Separation Scheme (TSS) and non-established extension; Established Gulf of Catalina TSS and non-established extension; non-established shipping lanes from the San Pedro Bay Channel west via Santa Rosa Island; and non-established shipping lanes from San Diego to San Pedro Bay. Service boats in the Santa Barbara Channel tracts could cross the Santa Barbara Channel TSS and dock at Port Hueneme. Service boats in the Santa Rosa and Tanner-Cortes Bank tracts could cross two shipping lanes and dock at Port Hueneme. Service boats in the Santa Barbara, San Pedro and Dana Point-San Diego tracts could cross shipping lanes and dock at Los Angeles or Long Beach Ports.

A crew boat could operate once a week for the drillships and pipe-lay barges. A supply boat could operate three times a week for both operations. The largest number of oil and gas activities per year are assumed to occur in 1982 when 6 drillships and 2 pipe-lay barges could be in operation simultaneously. Approximately 80 percent of these operations would occur in the Santa Barbara Channel and Tanner-Cortes Tracts.

In conclusion, the operation of drillships and pipe-lay barges could cause the following impacts: interfere with trawl fishing when operating in the Santa Barbara Channel and in water depths of less than 274 m (900 feet); interfere with the navigation when operating in the traffic lanes; and disturb the sea floor when drilling wells and laying pipelines. Also, the crew and supply boats could interfere with navigation when crossing the traffic lanes several times a week.

b. Platforms and Offshore Storage and Treating Facilities: The emplacement of platforms and offshore storage and treating facilities (OS&T) would disturb the sea floor and remove some fishing ground. Both structures could also impact navigation. The supporting foundation for the platform, the well drillings from the platform and the base for single anchor leg mooring (SALM) for OS&T facility would disturb the sea

floor and remove the fishing ground. Barging of the platform components to the construction site from the north (Oakland), and from the south (New Orleans), could impact navigation. The location of the platforms and OS&T facilities, and the number of services from the crew and supply boats to these structures could also impact navigation. Both types of structures could present a navigation problem when located near the traffic lanes. Crew and supply boats could also present a navigation problem when crossing the traffic lanes.

For the proposed sale area, an estimate of 31 platforms and 4 OS&T facilities could be constructed. Each platform could occupy approximately 0.4 ha (1 acre) of the sea floor and extend approximately 90 m (300 feet) above the ocean. A total of 13 ha (32 acres) of sea floor could be disturbed and removed from fishing. Each SALM would occupy an insignificant space on the sea floor, however, each OS&T facility could be a vessel with an approximate size of 100 feet wide by 750 feet long. Each platform and OS&L facility would need services from crew and supply boats. The number of trips by the crew boats and supply boats would depend on the number of crew shifts and the number of boats used to maintain both facilities. These crew and supply boats could cross the shipping lanes when shuttling between a port and offshore facilities.

c. Subsea Completion System: A drillship could install subsea completion systems. During installation of the subsea completion system, the sea floor would be disturbed from the anchor placement and well drilling. The subsea completion system, when installed in the Santa Barbara Channel in water depth of less than 274 m (900 feet), could interfere with trawl fishing. A single "wet tree" system could be approximately 3.7 m by 3.7 m by 5.2 m high (12 feet by 12 feet by 17 feet). A single "dry tree" system could be approximately 6.1 m by 6.1 m by 12.1 m high (15 feet by 15 feet by 30 feet high).

For the proposed sale area, an estimate of 71 subsea completion systems could be installed. Approximately 40 percent of these systems could be located in the Santa Barbara Channel, and another 40 percent in the Tanner-Cortes area.

d. Onshore Suppport Bases and Terminal: For the proposed sale area, the only new onshore facilities would be constructed during the offshore drilling operation when an estimate of four temporary operational bases could be constructed to store pipe and other drilling operation material. These bases would be centrally located and could be near the following ports: Santa Barbara, Port Hueneme, and two at Los Angeles-Long Beach. Each of these bases could occupy approximately 6 ha (15 acres). A total of 24 ha (60 acres) for the four bases could temporarily disturb normal onshore activities.

4. Impacts Resulting from Accidents

a. Probability of Oil Spills in the Southern California Bight: The North Sea and Gulf of Mexico are the two offshore areas that have been developed in which sufficient data on oil spills over a long period of time exists to provide a reasonable statistical base. Operational oil spill statistics for the Gulf of Mexico, while representing a much more severe environment than the Southern California Bight, have been used as the statistical base for this analysis.

The Gulf of Mexico records represent the most extensive data with respect to all phases of OCS oil field development in the United States.

The most important feature of oil spill statistics as reported by the Council on Environmental Quality (1974) is the size of individual spills. The statistics represent oil spills of all types (exploration, production, collisions, etc.) ranging in size from a few gallons to 150,000 barrels. Most spills are at the low end of this range. For example, in 1972, 96 percent of the spills were less than 24 barrels (1,000 gallons) and 85 percent were less than 2.4 barrels (100 gallons). A few very large spills account for most of the oil spilled. The TORREY CANYON accident of 1967 (860,000 bbls), for example, spilled twice as much crude oil as was reported spilled in the United States in 1970. In 1970 and 1972, three spills each year accounted for two-thirds of all the oil spilled in the United States navigable waters in those years. Because the total volume spilled per incident can vary by a factor of one million, it is difficult to estimate average amounts that might be spilled during the life of any field (Devanney and Stewart, 1974). Data supplied by the U.S. Geological Survey for the total period of 1964-1976 in the Gulf of Mexico indicates a total of 54 significant pollution incidents (50 bbls or more) connected with Federal OCS oil and gas operations.

On December 15, 1976, the Liberian-registered tanker ARGO MERCHANT ran aground on the Nantucket Shoals. The tanker broke apart on December 21, spilling 7.6 million gallons of No. 6 fuel oil. On January 4, the spill was floating 145 km (90 mi) from the coast covering an area 346 km (215 mi) long and 161 km (100 mi) wide. The spill was reported to have been caught up in a Gulf Stream eddy about 241 to 322 km (150 to 200 mi) east-southeast of the original spill site.

The estimated total amount of oil spilled during this period as a result of these incidents is over 326,000 barrels (13.7 million gallons). Table III.A.4.a-1 illustrates the distribution of Gulf

Table III.A.4.a-1

OIL SPILLS GREATER THAN 50 BARRELS IN THE GULF OF MEXICO, 1964-1976

Cause of Spill	Number of Incidents	% of Incidents	Barrels of Oil Spilled	% of Oil Spilled
1. Blowout	5	9.1	5,138	1.6
2. Hurricane Damage	6	10.9	14,357	4.4
3. Pipeline Breaks & Leaks				
a. Unknown Cause	7	12.7	8,209	2.5
b. Corrosion	4	7.3	5,564	1.7
c. Anchor Dragging	5	9.1	186,652	57.2
Subtotal	(16)	(29.1)	(200,425)	(61.4)
4. Fires	1	3.6	30,600	9.4
5. Barge Spills	3	5.5	7,340	2.2
6. Collisions	3	5.5	2,825	0.87
7. Production Equipment Malfunction				
a. Valves	4	7.3	365	0.11
b. Overflow of Vessel or Tank	10	18.2	1,113	0.34
c. Workover	1	1.8	53,000	16.2
d. Well Abandonment	1	1.8	500	0.15
e. Other Equipment Failures	4	7.3	10,500	3.2
Subtotal	(20)	(36.4)	(65,478)	(20.0)
Total	54	100.1	326,163	99.87

Source: USDI-GS, 1976.

of Mexico incidents as to type and barrels spilled. For example, pipeline breaks and leaks account for 29.1 percent of the 55 incidents but were the cause of 61.4 percent of oil spilled. Conversely, production equipment malfunctions of all types amounted to 36.4 percent of incidents and 20 percent of oil spilled (USDI-GS, 1976). Table III.A.4.a-1 is discussed further in the following subsections.

It is assumed that tanker or barge transportation will be utilized initially to bring produced oil to shore. As production increases, pipelines may be constructed and used to transport oil and gas to onshore terminals as discussed in Section III.A.4.a.iv. Onshore terminals will be used to load tankers for distribution to existing treatment facilities outside the area. The following discussion outlines the probabilities estimated from past experience, of oil spills caused by pipeline accidents, well blowouts, fires, tankers, and natural phenomena.

i. Oil and/or Gas Well Blowouts: It is possible for oil or gas to blow out of control during drilling operations, completion and production. Blowouts may be prevented during drilling by increasing mud weight and activating blowout preventers. When a well is completed, a subsurface safety device is installed to prevent the well from blowing out if surface control is lost. A gas well blowout will cause little or no pollution because it will burn or disperse into the atmosphere. An oil well blowout can release large quantities of drill mud, cuttings, sediment and some oil and gas into the marine environment.

Gulf of Mexico statistics show that during the period of 1956 to November 1, 1976 one blowout occurred for every 231 wells drilled, spilling an average of 1,053 barrels of oil each. Although there have been a total of 60 well blowouts since 1956, only 8 have resulted in significant volumes of oil spillage. In fact a single incident accounts for spillage of 53,000 barrels of the total of 63,193 barrels spilled by blowouts in the last 21 years in the Gulf of Mexico. Most blowouts causing spillage result from producing oil wells, not wells being drilled. Producing oil well blowouts are normally a result of equipment malfunctions, workover procedures, human errors, storms and collisions.

It is estimated that 787 exploratory, and development wells will be drilled as a result of the proposed sale. Based upon the above statistics in the Gulf of Mexico, there may be between one to three blowouts resulting in approximately 1,053 to 3,159 barrels of oil spilled during exploration and production in the Southern California lease area. While Gulf of Mexico data is not truly representative of Southern California conditions, it is the only statistical data available.

ii. Oil Spills Resulting From Explosions and Fires: Combustible hydrocarbon liquids or vapors making contact with arcing electrical or overheated mechanical devices undoubtedly cause most platform fires. More rarely, they are ignited by lightning

or static electricity. Sometimes platform fires involve the accidental ignition of fuel, solvent or heat exchanger fluids.

If producing wells are damaged to the extent that oil flows freely and ignites, they are usually allowed to burn while control operations are underway. In this way, most hydrocarbon liquid expelled by the well burns, reducing the fire hazard during relief operations and lowering ocean pollution levels. If a blowing well is releasing mostly natural gas, ocean pollution is minimal. However, personnel and the platform or drilling structure are imperiled in the event of a fire.

From 1956 to November 1, 1976, platform fires of varying species have occurred during OCS production in the Gulf of Mexico. Most were extinguished without causing serious damage or pollution. Of 189 recorded explosions and fires, only 19 resulted in oil spills amounting to a total of 87,132 barrels. Approximately one explosion and/or fire occurs for every 74 wells drilled, spilling an average of 461 barrels of oil. Assuming that an expected number of 787 wells will be drilled as a result of this proposed sale, between 3-10 explosions and/or fires could result during the expected production period.

From the data available and after careful analysis, the oil spill trajectory model (POCS Reference Paper No. VI) assumes a combined platform accident rate based on the amount of oil handled. This rate is 1.8 accidents of 1,000 bbls oil or more for every billion bbls of oil handled. For proposed Sale No. 48, 1.28 spills of 1,000 bbls or more are statistically expected to occur. See Table III.A.4.a.ii-1.

iii. Tanker Accidents and Operations: Because of the comparative low resource estimates in some tract groupings, distance to shore, economic considerations, and the position of the tract groups in relation to one another, it is more probable that tankers rather than pipelines will be used to transport oil from some of the groups. In other areas, it is possible that pipelines may be used instead of tankers and for this reason several scenarios have been studied in the oil spill trajectory model (POCS Reference Paper No. VI).

Tankers would probably be in the 16,000 to 25,000 dwt size class. Figure III.A.4.a.iii-1 shows the percentage of total outflow from various polluting sources. Table III.A.4.a.iii-1 shows the budget of petroleum hydrocarbons introduced into the oceans as compiled by the National Academy of Sciences (NAS, 1975). Figure III.A.4.a.iii-2 illustrates the percentage and amount of oil discharged by tanker accidents by type for 1969-1970. In the past, tanker operations included ballast discharge, tank washing, and bilge bunkering introduce ing several times as much oil into the oceans than is attributable to actual accidental spills.

Table III.A.4.a.ii-1

STATISTICALLY EXPECTED SPILLS OF 1,000 BBLs OR MORE (1979-2000)

Lease Area	Platform[a] Sale No. 48	Platform[a] Existing Leases	Pipelines[b] Sale No. 48	Pipelines[b] Existing Leases	Tankers[c] Sale No. 48	Tankers[c] Existing Leases	Sale No. 48 Total	SOHIO	Foreign Imports	All Cumulative
S.B. Channel	0.54	1.01	0.69	1.95	1.87	1.61	3.10	1.87	0.00	9.63
Santa Rosa	0.03	0.02	0.03	0.02	0.00	0.00	0.06	0.00	0.00	0.10
S.B. Island	0.02	0.03	0.00	0.00	0.04	0.06	0.06	0.00	0.32	0.47
Tanner-Cortes	0.50	0.97	0.64	1.24	0.00	0.00	1.14	0.00	0.32	3.67
San Pedro	0.14	0.27	0.18	0.35	0.15	1.68	0.47	1.87	0.32	4.96
Dana Point-San Diego	0.05	0.00	0.00	0.00	0.12	0.00	0.17	0.00	0.00	0.17
Totals	1.28	2.39	1.54	3.56	2.18	3.35	5.00	3.74	0.96	19.00

Source: POCS Reference Paper No. VI; Slack, 1978.

[a] Based on 1.8 spills of 1,000 barrels or more per billion barrels of production.

[b] Based on 2.3 spills of 1,000 barrels or more per billion barrels pipelined.

[c] Based on 3.9 spills of 1,000 barrels or more per billion barrels tankered.

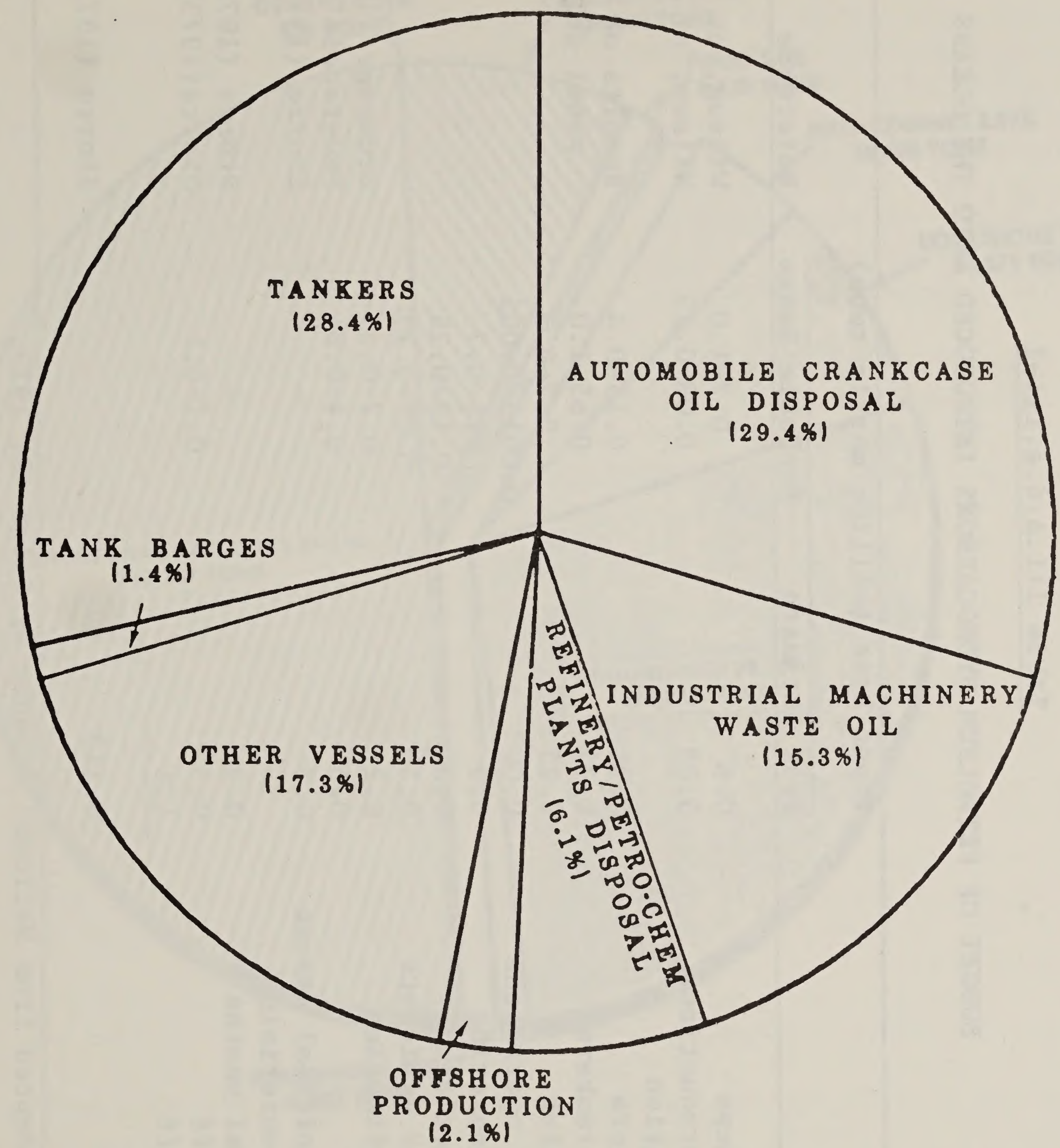


Figure III.A.4.a.iii-1 Sources of Oil Pollution to the Oceans

Source: Porricelli and Keith, 1973

Table III.A.4.a.iii-1

BUDGET OF PETROLEUM HYDROCARBONS INTRODUCED INTO THE OCEANS

Source	Input Rate (million metric tons)		Reference
	Best Estimate	Probable Range	
Natural seeps	0.6	0.2-1.0	Wilson, et al., (1973)
Offshore production	0.08	0.08-0.15	Wilson, et al., (1973)
Transportation			
LOT tankers	0.31	0.15-0.4	Results of workshop
Non-LOT tankers	0.77	0.65-1.0	panel deliberations
Dry docking	0.25	0.2-0.3	
Terminal operations	0.003	0.0015-0.005	
Bilges bunkering	0.5	0.4-0.7	
Tanker accidents	0.2	0.12-0.25	
Nontanker accidents	0.1	0.02-0.15	
Coastal refineries	0.2	0.2-0.3	Brummage (1973a)
Atmosphere	0.6	0.4-0.8	Feuerstein (1973)
Coastal municipal wastes	0.3	-	Storrs (1973)
Coastal, nonrefining, industrial wastes	0.3	-	Storrs (1973)
Urban runoff	0.3	0.1-0.5	Storrs(1973) Hallhagen
River runoff	1.6	-	
Total	6.113		Storrs (1973) Hallhagen

Source: Adapted from National Academy of Sciences, 1975.

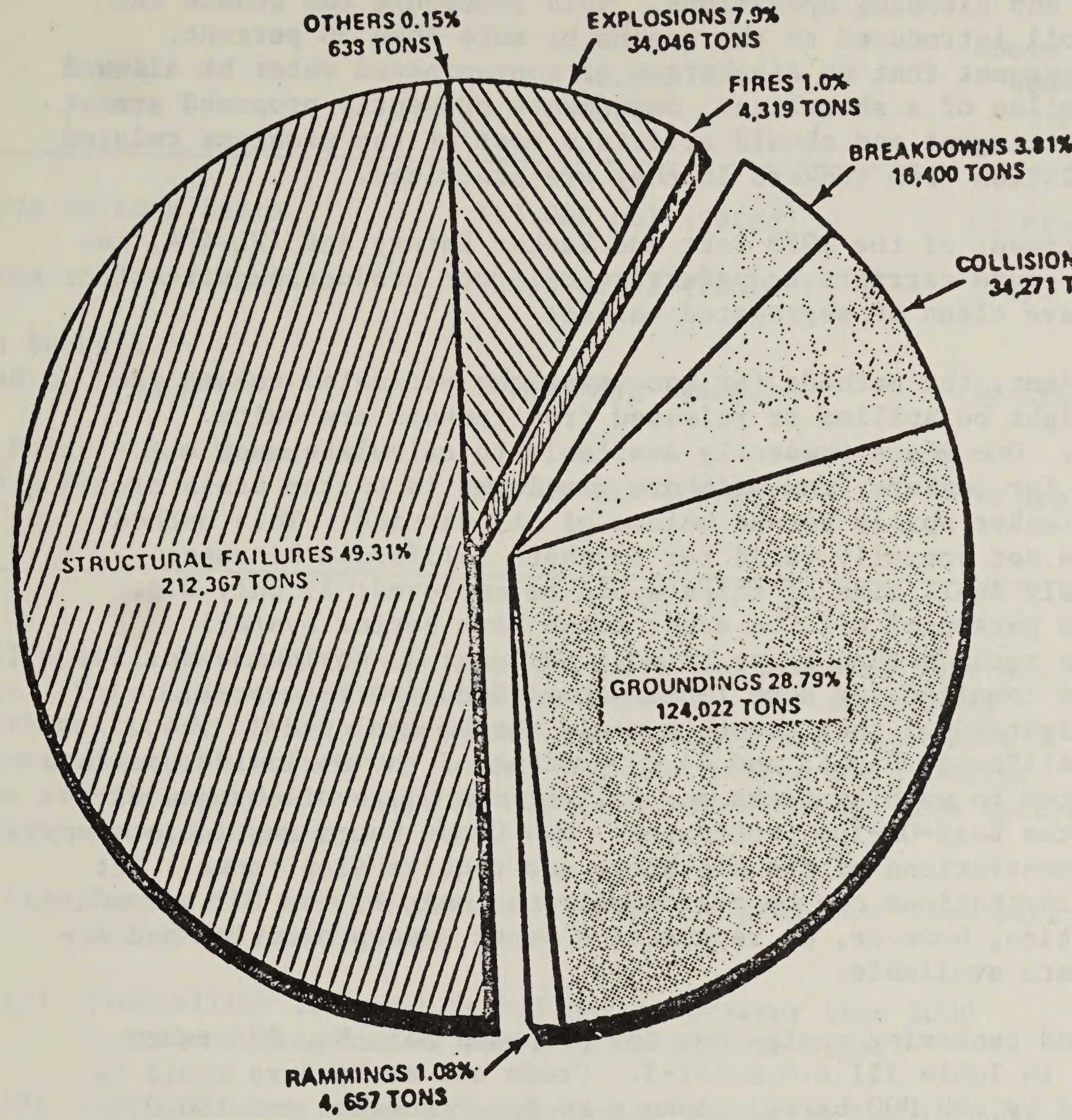


Figure III.A.4.a.iii-2 1969-1970 Tanker Polluting Incidents, Percentage Oil Outflow by Type of Accident

Source: Porricelli and Keith, 1973

To alleviate this problem, both international and internal regulations have been promulgated. The intergovernmental Maritime Consultative Organization (IMCO), a voluntary membership organization, has proposed the Load-On-Top (LOT) procedure, among many others, as the best method of eliminating the problem of oil discharge, from tanker ballasting and cleaning operations. This procedure can reduce the amount of oil introduced to the oceans by more than 50 percent. They also suggest that no discharges of contaminated water be allowed within 50 miles of a shoreline. Amendments presently proposed are even more stringent and should alleviate most of the problems related to oil pollution from tankers if they are practiced.

Recent enactment of the 1978 Port and Tanker Safety Act (PL-474) requires all crude carriers transferring oil from production sites to shore to have clean or segregated ballast.

At the present, the methods for computing the estimated volume of oil that might be spilled or released from tankers are quite inaccurate. One means presently available to calculate such a percentage for tankers from offshore platforms is on the basis of worldwide tanker spills versus volume of oil carried. This method, however, is not actually valid for Southern California because: 1) relatively small size of ships would be employed; 2) only U.S. vessels and personnel will be used; these have better overall performance records than those of most nations; 3) worldwide spill records are compiled for some tanker operations (port-to-port, barging, lightering) that probably would not be employed in the Southern California Bight; and 4) 84 percent of the worldwide spillage is attributed to washing tanks and ballast and bilge discharges without using the Load-On-Top procedures. New Coast Guard regulations apply to oil concentrations of the discharge and require slop tanks. But discharge limitations can be practically met only by the LOT procedure. The statistics, however, do represent a worst case projection and are the best data available.

Four assumed tankering routes for the proposed Sale No. 48 tracts are listed in Table III.A.4.a.iii-3. Crude oil at Ventura could be transported by 400,000-barrel tankers to San Francisco and 150,000-barrel barge to Long Beach. Crude oil from the storage and process facility at Santa Barbara Island and Dana Point-San Diego tracts could be transported by 10,000-barrel barge to Long Beach.

Table III.A.4.a.iii-2

TANKER ROUTES FOR PROPOSED SALE NO. 48 TRACTS

Tanker Routes	Tanker Size	Route Trip Travel Time
Ventura to Long Beach	150,000 bbl (Barge)	65 hrs.
Ventura to San Francisco	400,000 bbl (Tanker)	5-1/2 days
Santa Barbara Island to Long Beach	10,000 bbl (Barge)	30 hrs.
Dana Point - San Diego to Long Beach	10,000 bbl (barge)	54 hrs.

An oil spill risk analysis was conducted for the proposed Sale No. 48 tracts. This analysis (POCS Reference Paper No. VI) determines the probability of spill occurrences and reaching the shorelines and environmentally sensitive areas. Assumed tanker and pipeline routes are illustrated in Figures III.A.4.a.iii-3 and 4. The analysis is based on the following:

(1) Future oil spill occurrences could be projected from past OCS spill experiences.

(2) Probability is based on oil spills greater than 1000 barrels during the 22 years of production life.

(3) The following three transportation scenarios were considered:

  (a) Mixed A (Sale No. 48 most probable, and spills from platforms, tankers and pipelines).

  (b) Mixed B, same as Mixed A except alternate pipelines from Santa Rosa Island to Ventura.

  (c) One hundred percent tanker.

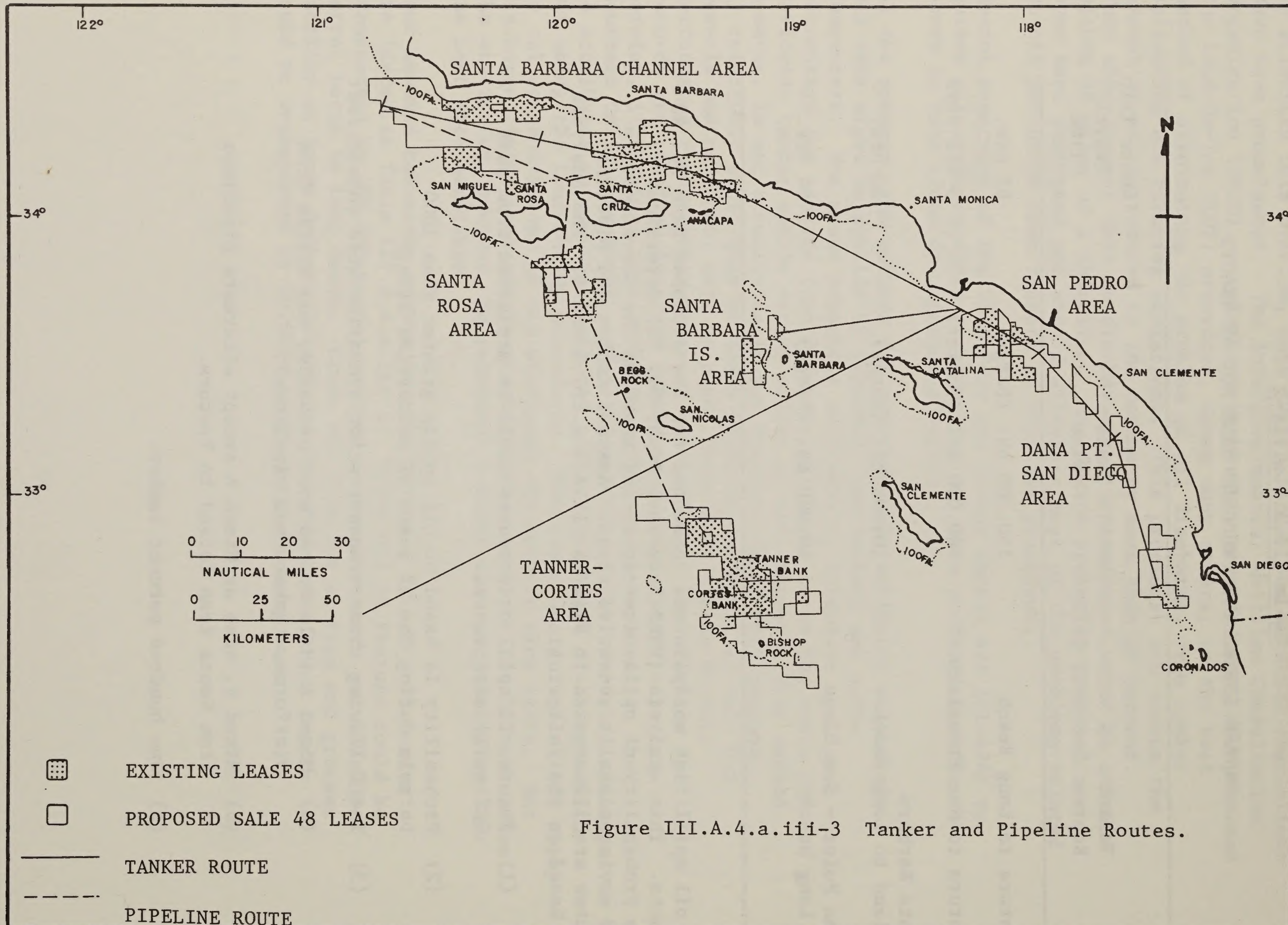


Figure III.A.4.a.iii-3 Tanker and Pipeline Routes.

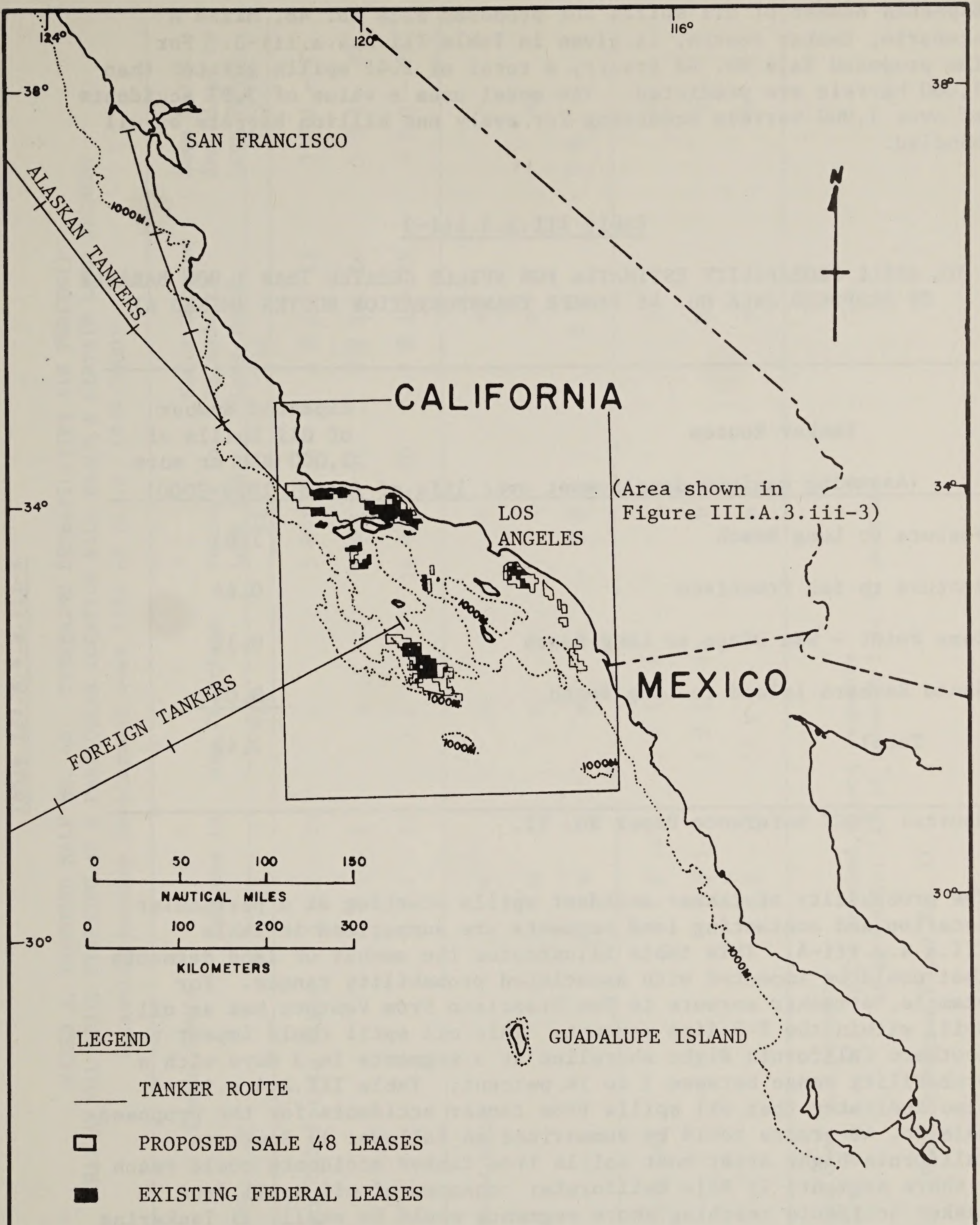


Figure III.A.4.iii-4 Proposed OCS Sale No. 48 Tanker Routes.

Source: POCS Reference Paper No. VI

Expected number of oil spills for proposed Sale No. 48, Mixed A scenario, tanker routes, is given in Table III.A.4.a.iii-3. For the proposed Sale No. 48 tracts, a total of 2.42 spills greater than 1,000 barrels are predicted. The model uses a value of 3.87 accidents of over 1,000 barrels occurring for every one billion barrels of oil handled.

Table III.A.4.iii-3

OIL SPILL PROBABILITY ESTIMATES FOR SPILLS GREATER THAN 1,000 BARRELS OF PROPOSED SALE NO. 48 TANKER TRANSPORTATION ROUTES (MIXED A)

Tanker Routes (Assuming maximum development over life of field, 1979-2000)	Expected Number of Oil Spills of 1,000 BBL or more
Ventura to Long Beach	1.61
Ventura to San Francisco	0.65
Dana Point - San Diego to Long Beach	0.12
Santa Barbara Island to Long Beach	0.04
Total	2.42

Source: POCS Reference Paper No. VI.

The probability of tanker accident spills starting at a particular location and contacting land segments are summarized in Table III.A.4.a.iii-4. This table illustrates the number of land segments that could be impacted with associated probability ranges. For example, a tanker enroute to San Francisco from Ventura has an oil spill within the T-5 line segment. This oil spill could impact the Southern California Bight shoreline at 3 segments in 3 days with a probability range between 1 to 14 percent. Table III.A.4.a.iii-4 also indicates that oil spills from tanker accidents for the proposed Sale No. 48 tracts could be summarized as follows: 1) Southern California Bight area; most spills from tanker accidents could reach a shore segment; 2) Baja California: chances of oil spill from tanker accidents reaching shore segments would be small; 3) Tankering

Table III.A.4.a.iii-4

MIXED A, PROPOSED SALE NO. 48. TANKERING PROBABILITIES (IN PERCENT) THAT AN OIL SPILL STARTING AT A PARTICULAR LOCATION WILL REACH A CERTAIN LAND SEGMENT

(Assuming maximum development over life of field, 1979-2000)

Days	Location \ Tanker Route	Ventura to	San Francisco	Ventura to Long Beach	Santa Barbara Islands to Long Beach	Dana Point - San Diego to Long Beach
		T5	T10	T8	T24	T25
3	Southern California Bight	3 @ 1 - 14	n	5 @ 1 - 14	4 @ 1 - 13	3 @ 1 - 4
10		5 @ 1 - 7	n	7 @ 1 - 25	0 @ 1 - 26	5 @ 1 - 22
60		8 @ 1 - 27	1 @ 1	16 @ 1 - 30	7 @ 1 - 29	8 @ 1 - 25
3	Baja California	n	n	n	n	n
10		n	n	n	n	n
60		n	n	1 @ 1	2 @ 1	7 @ 1 - 7
3	Tankering Leg	1 @ 12	3 @ 1 - 6	n	n	n
10		1 @ 1	5 @ 1 - 14	n	n	n
60		3 @ 2 - 18	13 @ 1 - 17	n	n	n

n = Less than 0.5 percent
Example: 8 @ 1 - 27: Spill reached 8 land segments at probabilities of between 1 to 27 percent

Source: POCS Reference Paper No. II.

leg (Point Conception to Port Eyes); only the oil spills from tanker accidents along the Ventura to San Francisco tanker route could impact a shoreline segment.

Cumulative impacts are presented in Table III.A.4.a.iii-5 as comparison in the probability of oil spills from tankering between the proposed Sale No. 48 tracts, existing Federal leases, Alaskan tankers, and foreign tankers. The expected number of spills for the proposed Sale No. 48 is 2.42; cumulatively, 10.47.

Table III.A.4.a.iii-5

OIL SPILL PROBABILITY ESTIMATED FOR SPILLS GREATER THAN 1,000 BARRELS OF TANKER TRANSPORTATION
(Assuming maximum development over life of field, 1979-2000)

Tanker Routes		Expected Number of Oil Spills
Mixed A	Proposed Sale No. 48	2.42
	Existing Federal Leases	3.35
Alaskan Tankers		3.74
Foreign Tankers		0.96
Cumulative		10.47

Source: POCS Reference Paper No. VI.

iv. Pipeline Accidents: Since the USGS OCS Operating Orders concerning pipelines went into effect in 1970, pipeline breaks and leaks accounted for 29.0 percent of the significant pollution incidents and 27.7 percent of oil spilled. These data refer to the Gulf of Mexico which has the longest Federal OCS record and the most offshore pipeline activity of any area in the United States. Oil spilled by pipeline accidents account for approximately 0.0014 percent of the total production in the Gulf of Mexico.

Since 1970, 72.9 percent of the total volume of oil spilled by pipelines and 37.5 percent of the accidents are believed to be the result of ship anchors dragging across a pipeline causing it to rupture. Other causes of pipeline damage include movement due to wave action during storms, impact of trawl boards of commercial fishing boats, and corrosion of the pipe due to formation water that is produced with the oil. The pipelines are protected cathodically with zinc anodes and an internal corrosion inhibitor is injected with production through the line. Occasionally small pits form on the interior walls of the pipeline as the line gets older.

Using USGS high recovery estimates, there will be a total of 660 km of oil pipelines constructed during the 25-year life of the field. In the Gulf of Mexico there is currently over 7700 miles of oil and gas pipelines. At least 1000 miles of those 7700 miles are oil pipelines. According to USGS there have been 16 pipeline breaks and leaks of over 50 barrels of oil from 1964 to 1976. There have been 6 spills of the 16 that were greater than 1000 barrels each.

Based on the volume of oil handled, the oil spill model uses a value of 2.3 accidents of 1,000 barrels or more for every billion barrels of oil handled.

Assumed submerged pipelines for the proposed Sale No. 48 tracts are illustrated in Figure III.A.4.a.iii-3. There are an estimated 660 km (408 miles) of crude oil pipelines in water depth not exceeding 520 m (1700 feet). These estimated pipeline systems are: Santa Barbara Channel, 305 km (190 miles) and 3 pipeline platforms; Tanner-Cortes Banks, 300 km (186 miles) and 4 pipeline platforms; San Pedro, 51 km (32 miles) and no platforms; Santa Rosa Island and Santa Barbara Island, no pipeline; and Dana Point-San Diego, no crude oil pipelines.

Direction of an oil spill would depend on the location and the surrounding environmental condition.

The oil spill risk analysis is described in the Tanker Accident Section III.A.4.iii. This analysis determines the probabilities of oil spills reaching segments from the following pipeline routes: Tanner-Cortes Bank to Santa Rosa tracts to Ventura and Santa Barbara Channel to Ventura. Also, the San Pedro tracts to Long Beach.

The estimated number of oil spills greater than 1000 barrels from the proposed Sale No. 48 pipeline routes are tabulated in Table III.A.4.a.iv-1. Expected number of oil spills from each of the three pipeline routes is less than one; from the total pipeline transportation, 1.54.

The probabilities of an oil spill from pipeline accidents contacting land segments are tabulated in Table III.4.a.iv-2. Probabilities of an oil spill from location L1, Tanner-Cortes Bank to Santa Rosa to Ventura Pipeline, reaching land segments of the Southern California Bight Shoreline within 3 days are 8, and 13. (This means that the oil spill could reach 2 shoreline segments with probabilities of 8 and 13 percent). Table III.4.a.iv-2 also indicates that oil spills from pipeline accidents could have the following probabilities of impacting the shorelines: Southern California Bight, 1 to 58 percent; Baja California, less than 0.5 percent; and Tanker Leg (Point Conception to Point Reyes), 1 to 9 percent.

Cumulative impact of expected number of oil spills from all the proposed pipeline routes is tabulated in Table III.A.4.a.iv-1. The combined expected number of oil spills over 1000 barrels are 5.10.

Table III.A.4.a.iv-1

OIL SPILL PROBABILITY ESTIMATE FOR SPILLS GREATER THAN 1,000 BARRELS OF PIPELINE TRANSPORTATION (MIXED A)

(Assuming maximum development over life of field, 1979-2000)

	Expected Number of Oil Spills 1,000 BBL or Greater		
Pipeline Routes	Proposed Sale No. 48	Existing Federal Leases	Combined
Santa Barbara Channel to Ventura	0.69	1.95	2.64
Tanner - Cortes Bank to Ventura	0.67	1.26	1.93
San Pedro Bay to Long Beach	0.18	0.35	0.53
Total	1.54	3.56	5.10

Source: POCS Reference Paper No. VI.

v. Natural Phenomena: The preceeding sections dealt with estimates on the volume of oil that may be spilled annually as a result of human error and/or equipment failure. There is also the very low possibility that a spill may occur due to natural

Table III.A.4.a.iv-2

MIXED A, PROPOSED SALE NO. 48 PIPELINE PROBABILITIES
THAT AN OIL SPILL STARTING AT A PARTICULAR
LOCATION WILL REACH A CERTAIN LAND SEGMENT
(Assuming maximum development over life of field, 1979-2000)

Land Segments Impacted Within	Impact Locations	Pipeline Tanner - Cortes Bank to Ventura		Pipeline Santa Barbara Channel to Ventura	
		L1	L5	L6	L8
3 Days	Southern California Bight	2 @ 8 - 13[b]	3 @ 1 - 36	5 @ 1 - 45	2 @ 20& 34
10 "		3 @ 1 - 13	7 @ 1 - 36	7 @ 1 - 56	5 @ 1 - 43
30 "		4 @ 1 - 14	8 @ 1 - 37	10 @ 1 - 58	7 @ 1 - 40
60 "		8 @ 1 - 14	11 @ 1 - 37	11 @ 1 - 58	8 @ 1 - 44
3 "	Baja California	n[a]	n	n	n
10 "		n	n	n	n
30 "		n	n	n	n
60 "		n	n	n	n
3 "	Tankering Leg	n	1 @ 1	n	1 @ 4
10 "		n	n	n	1 @ 1
30 "		n	1 @ 2	2 @ 1 & 33	2 @ 1 & 9
60 "		n	1 @ 2	3 @ 1 - 4	3 @ 1 - 9

Source: POCS Reference Paper No. VI.

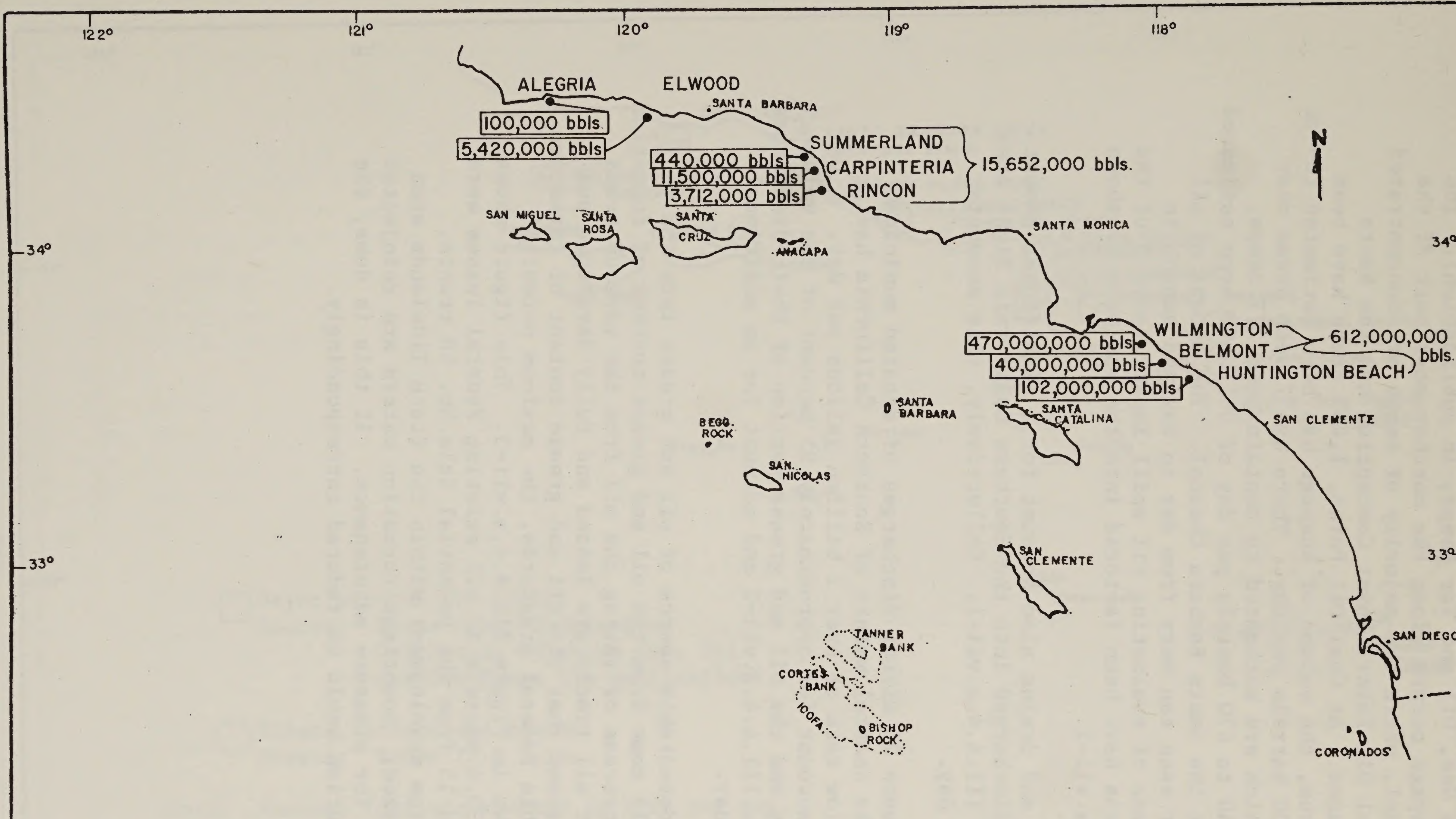
[a]n = Less than 0.5 percent.
[b]Example: 8 @ 1 - 44: Spill reached 8 land segments at probabilities between 1 to 44 percent.

phenomena such as earthquakes, and a still lower possibility of a spill due to tsunami. Unfortunately, there is no data available for which a reasonable prediction could be made for the Southern California area. Existing predictions are based on data and studies from the Gulf of Mexico and the North Sea. These areas are not representative of the Southern California Bight. The Uniform Building Code (1973 edition) shows the Gulf of Mexico with a seismic risk factor of "0," while Southern California has the maximum risk factor of "3." Both the oil companies and the regulatory agencies are concerned about these factors in the Southern California Bight area and the "API Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms (1975)" is carefully adhered to when approving platform designs. There has never been an offshore accident in Southern California attributable to natural causes alone and, therefore, due to the lack of appropriate data, these were not factored into the oil spill risk model.

vi. State Tidelands Oil Production: The oil spill risk model (POCS Reference Paper No. VI) assumes 1.8 platform-related spills of 1,000 barrels or more for every billion barrels of oil produced and 2.3 pipeline related spills for every billion barrels of oil taken from the OCS area. There are a number of proven oil reserves being actively developed in the Southern California Bight (Figure III.A.4.a.vi-1). Platforms within the State Tidelands waters were not included in the oil spill risk modeling because the model is not accurate for spills close to shore and it can also be assumed that a spill of 1,000 barrels or more occurring from one of these platforms or pipelines (by definition of State Tidelands they are within 3 nautical miles of shore) will definitely reach the nearby shoreline. Therefore, the same criteria is used for these platforms and will be added where appropriate to the oil spill risk model data. It has been assumed that all the oil from each field is going directly to shore by pipeline. The estimated number of spills for each area is as follows:

Area	Estimated No. of Spills (22-year period)
Alegria	0.0004
Elwood	0.0222
Summerland	0.00]8
Carpinteria	0.0472
Rincon	0.0152
Wilmington	1.9270
Belmont	0.1640
Huntington Beach	0.4182

vii. Other Hydrocarbon Sources: At the present time, more than 2000 oil and gas seepage zones have been located in the Southern California offshore area (State Lands Commission,



Source: 62nd Annual Report of the State Oil and Gas Supervisor, 1976.

Figure III.A.4.a.vi-1 Estimated California State Tidelands Oil Reserves.

California Offshore Gas, Oil and Tar Seeps, In publication). The most widespread seepage occurs along the northernmost part of the Santa Barbara Channel, where the majority of seeps are concentrated in three areas, Coal Oil Point, Point Conception and the Santa Barbara to Rincon area. At Coal Oil Point, 1,465 seeps have been mapped. In this area, the volume of seepage has been estimated to range from 25 to 400 barrels per day. There are 7 seep areas near Point Conception which are estimated to contain some 277 seeps. Somewhere between 40 to 670 barrels per day of oil have been estimated to occur throughout the Santa Barbara Channel. The amount of oil from any particular seep can vary from day to day and season to season. For purposes of evaluating oil spill impact, only 3 of the more consistent seeps have been factored into the analysis as shown in Figure III.A.4.a.vii-1.

The rivers, creeks and drains also account for a significant amount of oil and grease discharged into the Southern California Bight area as shown in Figure III.A.4.a.vii-1. Collectively, this accounts for 91 barrels per day.

As of 1971, there were 25 direct discharges of treated municipal waste water into the coastal waters of Southern California having a combined total flow rate of over 1 billion gallons per day. Five of these outfalls account for approximately 95 percent of the volume. These five outfalls and the oil and grease portion of their discharges are shown on Figure III.A.4.a.vii-2 and account for an additional 1,152 barrels per day.

Another small but detectable source of oil and grease into the offshore waters will come from the oil and grease content of formation waters during the process of taking the oil from the various areas. If one assumes that all tracts are leased and fully developed and in addition one assumes that the oil and grease content of formation waters is just within Federal standards, the maximum potential discharges are shown in Figure III.A.4.a.vii-3. This figure shows a maximum rate of 30.4 barrels if all existing Federal leases were fully developed and 15 from the potential Sale No. 48 tracts. Formation waters from development within the State Tidelands area have not been analyzed. Sometimes formation waters are reinjected into the structure for pressure maintenance. If this is done, the corresponding pollution would be reduced correspondingly.

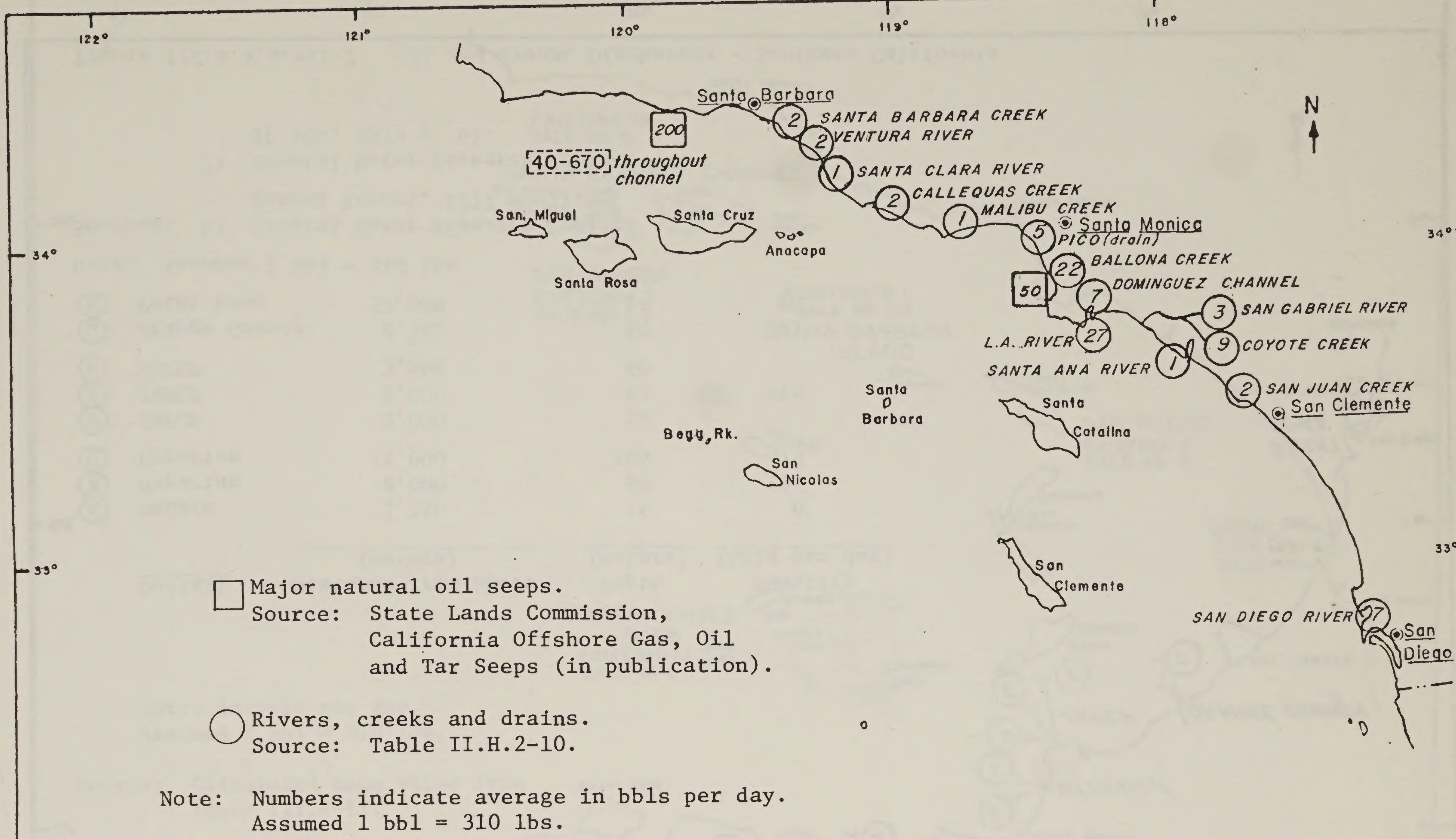
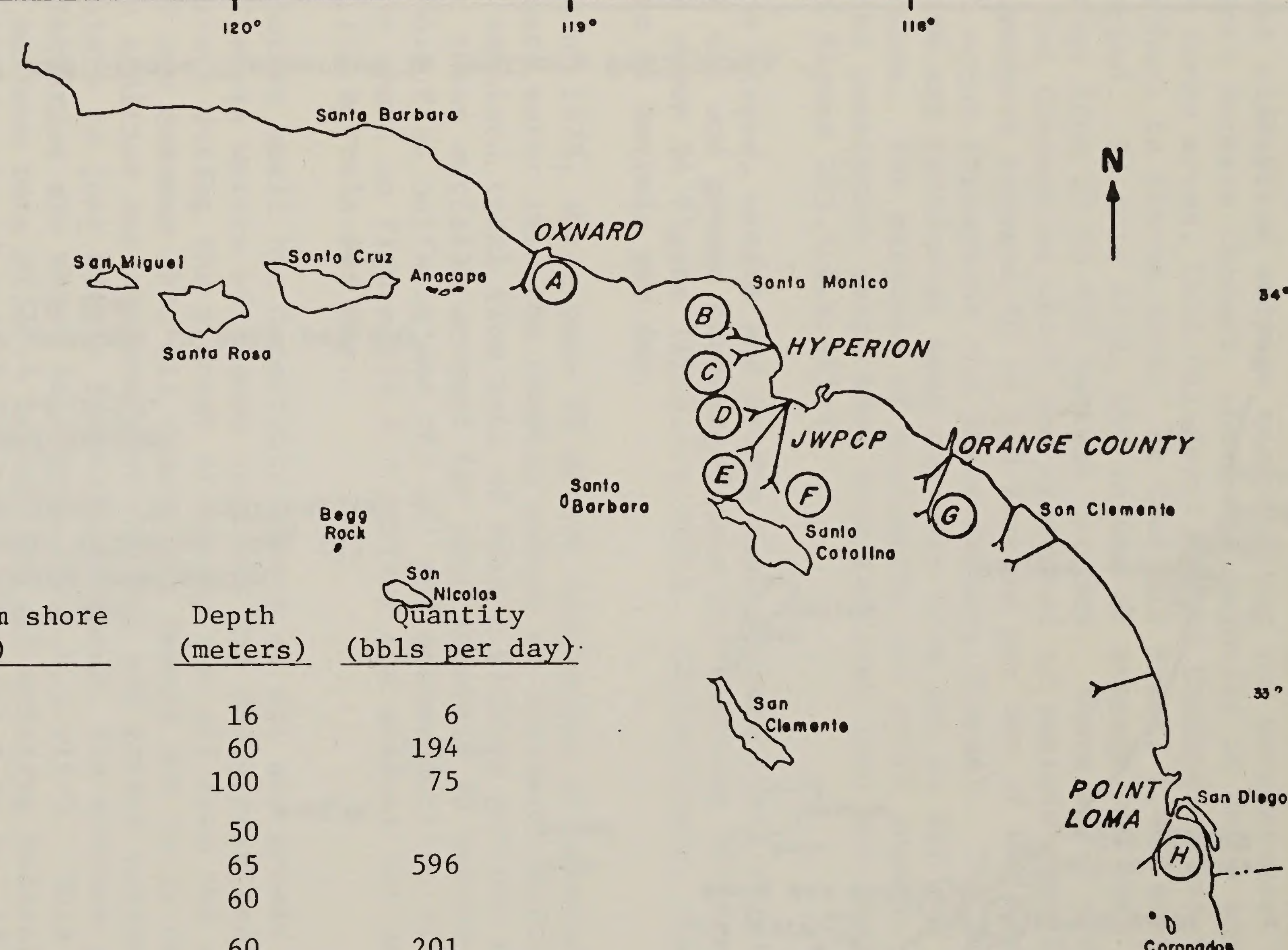


Figure III.A.4.a.vii-1 Oil and Grease Discharges in Southern California



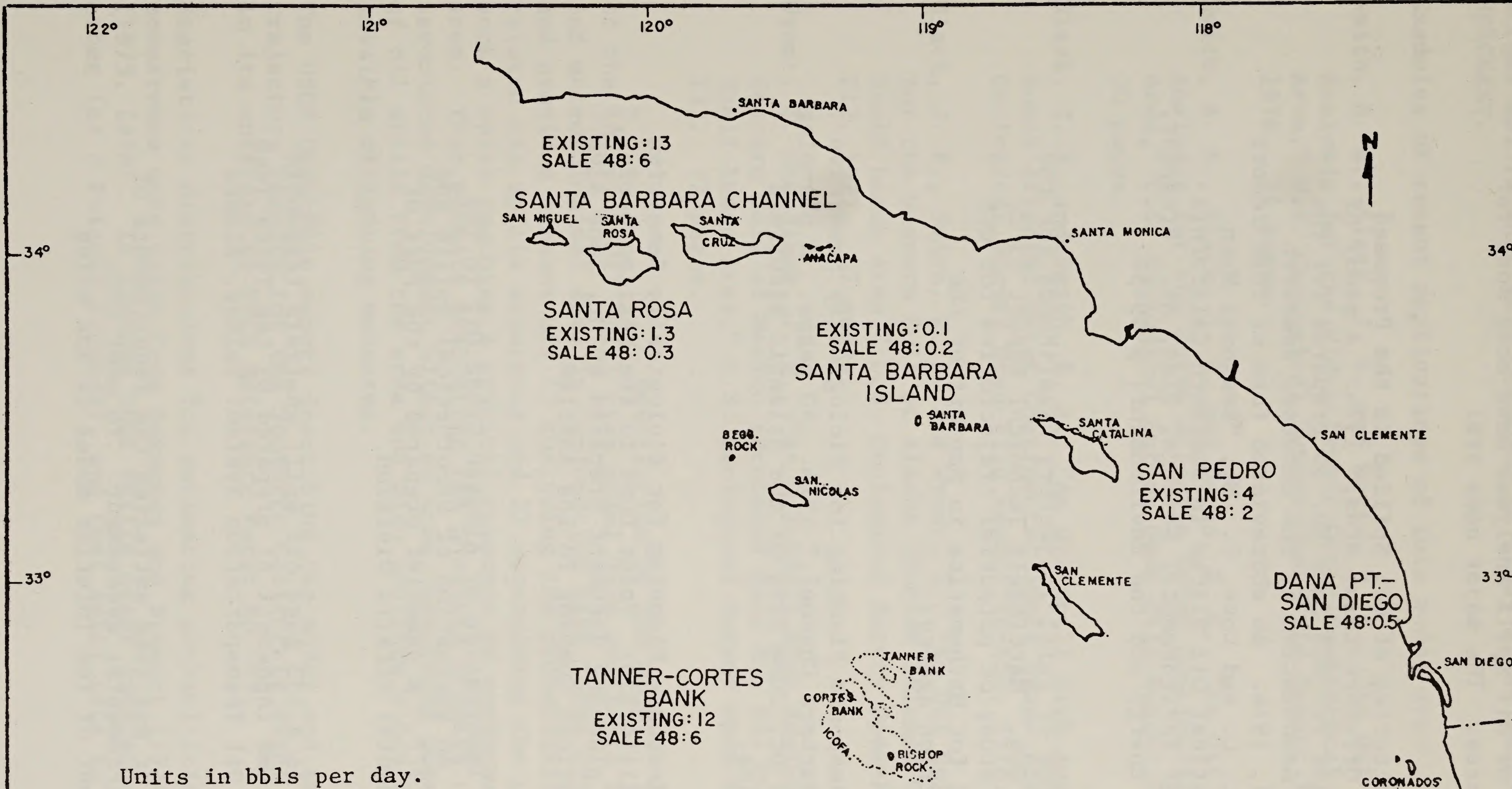
	Outfall	Distance from shore (meters)	Depth (meters)	Quantity (bbls per day)
A	Oxnard	1,750	16	6
B	Hyperion	8,000	60	194
C	Hyperion	11,000	100	75
D	JWPCP	2,000	50	
E	JWPCP	2,600	65	596
F	JWPCP	3,600	60	
G	Orange County	8,300	60	201
H	Point Loma	32,000	64	80

Note: Assumed 1 bbl = 310 lbs.

Sources: 1) Coastal Water Research Project Annual Report, 1977 p. 21.

2) Coastal Water Research Project TR 104, 1973 p. 61.

Figure III.A.4.a.vii-2 Oil and Grease Discharges - Southern California



Units in bbls per day.
Assumed 1 bbl = 310 lbs.

Source: Calculated mean value from Table III.A-11.

Figure III.A.4.a.vii-3 Potential Oil and Grease Discharges from formation waters - Southern California (Note: Values indicate total area if all tracts are leased and developed)

b. Sale No. 48 Oil Spill Trajectories: Over the last few years, a number of oil spill analyses have been done for the Southern California area. The major ones are:

"Study of Potential Trajectories of Oil Spilled in the Proposed Southern California Offshore Lease Area," 1974. A study of potential trajectories for OCS Sale No. 35 prepared for the Western Oil and Gas Association by the Intersea Research Corporation in April, 1974. An abbreviated form of this report appears as: Adamo, L. C. and Love, C. M., "Seasonal Mean Transport of Hypothetical Oil Slicks in Southern California Waters," Institute of Environmental Science, 21st, Mt. Prospect, Ill., 1975, Vol. 1, Energy and the Environment. p 49-54.

Devanney, J. W., "Estimates of Spill Trajectory Likelihoods for the Southern California OCS," Martingale Technical Report 75-2, 1975. 129 pages, a study of potential trajectories for OCS Sale No. 35 prepared for Mathematica in Support of the Environmental Protection Agency.

Siva, J. L., "Oil Spill Response Planning for Biologically Sensitive Areas of the Santa Barbara Channel," 1976. 40 pages. A planning document prepared by Dr. June Siva of the Atlantic Richfield Company in Los Angeles.

Siva, J. L., "Oil Spill Response Planning for Biologically Sensitive Areas in Southern California: Point Dume to the Mexican Border," 1977. 96 pages. A planning document prepared by Dr. June Siva of the Atlantic Richfield Company in Los Angeles.

Port of Long Beach, "The Importation of Alaskan Crude Oil to the Port of Long Beach: An Evaluation of Hypothetical Spills and Their Mitigation," 1977. A pamphlet prepared by the Port of Long Beach, Environmental Affairs Division.

Tetra Tech., 1977. This is a 133 page oil spill analysis (Appendix B) and an 11 map volume (Appendix A) prepared by the Tetra Tech Corp. for the SOHIO Oil Transportation System: Valdez, Alaska to Long Beach, CA.

None of the above models or analyses satisfies the requirements of an analysis for this environmental assessment. To meet this requirement, the Department of the Interior model is now being

applied to all OCS Sales and has also correlated very well with actual spills that have occurred in study areas such as the ARGO MERCHANT.

Examples of recent applications of this model are:

Smith, R. A., Slack, J. R. and Davis, R. K., "An Oil spill Risk Analysis for the Mid-Atlantic Outer Continental Shelf Lease Area," U.S. Geological Survey Open-File Report 76-451, June 1976. 24 pages.

Smith, R. A., Slack, J. R. and Davis, R. K., "An Oil Spill Risk Analysis for the North Atlantic Outer Continental Shelf Lease Area," U.S. Geological Survey Open-File Report 76-620, 1976. 50 pages.

Slack, J. R. and Smith, R. A., "An Oil Spill Risk Analysis for the South Atlantic Outer Continental Shelf Lease Area," U.S. Geological Survey Open-File Report 76-653, 1976. 54 pages.

Slack, J. R., Smith, R. A. and Wyant, T., "An Oil Spill Risk Analysis for the Western Gulf of Alaska (Kodiak Island) Outer Continental Shelf Lease Area," U.S. Geological Survey Open-File Report 77-212, 1977. 57 pages.

Wyant, T. and Slack, J. R., "An Oil Spill Risk Analysis for the Eastern Gulf of Mexico (Proposed Sale No. 65) Outer Continental Shelf Lease Area," U.S. Geological Survey Open-File Report 78-132. 72 pages.

i. Description of the Model: The Department of the Interior Oil Spill risk model uses available oceanographic and meteorological data in conjunction with local critical resources and provides a means of: 1) analyzing the probabilities of OCS related oil spills occurring and 2) determining the probability of such a spill reaching a critical resource or environmentally sensitive area. This permits evaluating the possible effects of drilling and associated development within an area, assessing possible impacts of oil spills from the area and also provides a basis for evaluating possible mitigating measures.

The USGS Open-File report describing the model and the detailed trajectory results for the Southern California Bight is reproduced in its entirety as POCS Reference Paper No. VI.

Statistical distributions for estimating probabilities of oil spill occurrence were taken from Devanney and Stewart (1974) and Stewart (1975, 1976). It assumes that spills occur independently of each other (as a Poisson process), and that spill rate is dependent on

volume of oil produced and handled. The following ratios are used and indicate the expected number of spills over 1,000 barrels in size for every billion barrels of oil produced and handled: Platforms = 1.8, Tankers = 3.87, and pipelines = 2.3. The probability and spill frequency distributions related to proposed and existing lease activity is shown in Figure III.A.4.b.i-1.

Representative spill sites were selected for analysis. To evaluate cumulative effects, 13 (E1-E13) potential spill points were selected from each of the five existing Federal OCS lease areas as shown in Figure III.A.4.b.i-2. Twenty-three (P1-P23) potential spill points were selected from within the six areas being evaluated for Sale No. 48 as shown in Figure III.A.4.b.i-3. Tanker routes were broken up into line segments with the probability of a spill point averaged along the length of each segment. As shown in Figure III.A.4.b.i-4 and III.A.4.b.i-5, importation of Alaskan oil is represented by segments T1 through T8; and importation of foreign oil is represented by segments T15 through T20. It is estimated that during the 22-year period being evaluated, 5,600 million barrels of oil will be shipped to Long Beach from Alaska and 2,400 million barrels will arrive from foreign sources. Using the criteria discussed earlier, this could result in 31 oil spills of over 1,000 barrels in size along the entire routes. It has been assumed for evaluation that 50 percent or 15 spills could occur within the study area. Tanker routes related to existing and potential Sale No. 48 development are represented by line segments T9 through T14 and T20 through T27. Possible pipeline routes associated with the potential Sale No. 48 development are shown in Figure III.A.4.b.i-5 as L1 through L8. In some cases, tanker leg segments will double for pipeline segments such as T27.

Trajectories of 500 hypothetical oil spills were simulated in Monte Carlo fashion for each of the four seasons (Winter = Dec., Jan., Feb.; spring = Mar., Apr., May; summer = Jun., Jul., Aug.; fall = Sept., Oct., Nov.) for each of the potential sources to be evaluated. Depending upon its shape, each potential spill source was represented as either a single point (e.g., a small lease area), or as a straight line with the potential spills uniformly distributed along the line (e.g., a transportation route). Surface transport of the oil slick for each spill was simulated as a series of straight-line displacements of a point under the joint influence of wind and surface currents on the slick for a 3-hour period. The local wind transition probability matrix was randomly sampled each period for a new wind speed and direction, and the current velocity was updated as the spill changed location in the velocity field. The wind drift factor was taken to be 0.035 with a drift angle (Coriolis force) of 20 degrees.

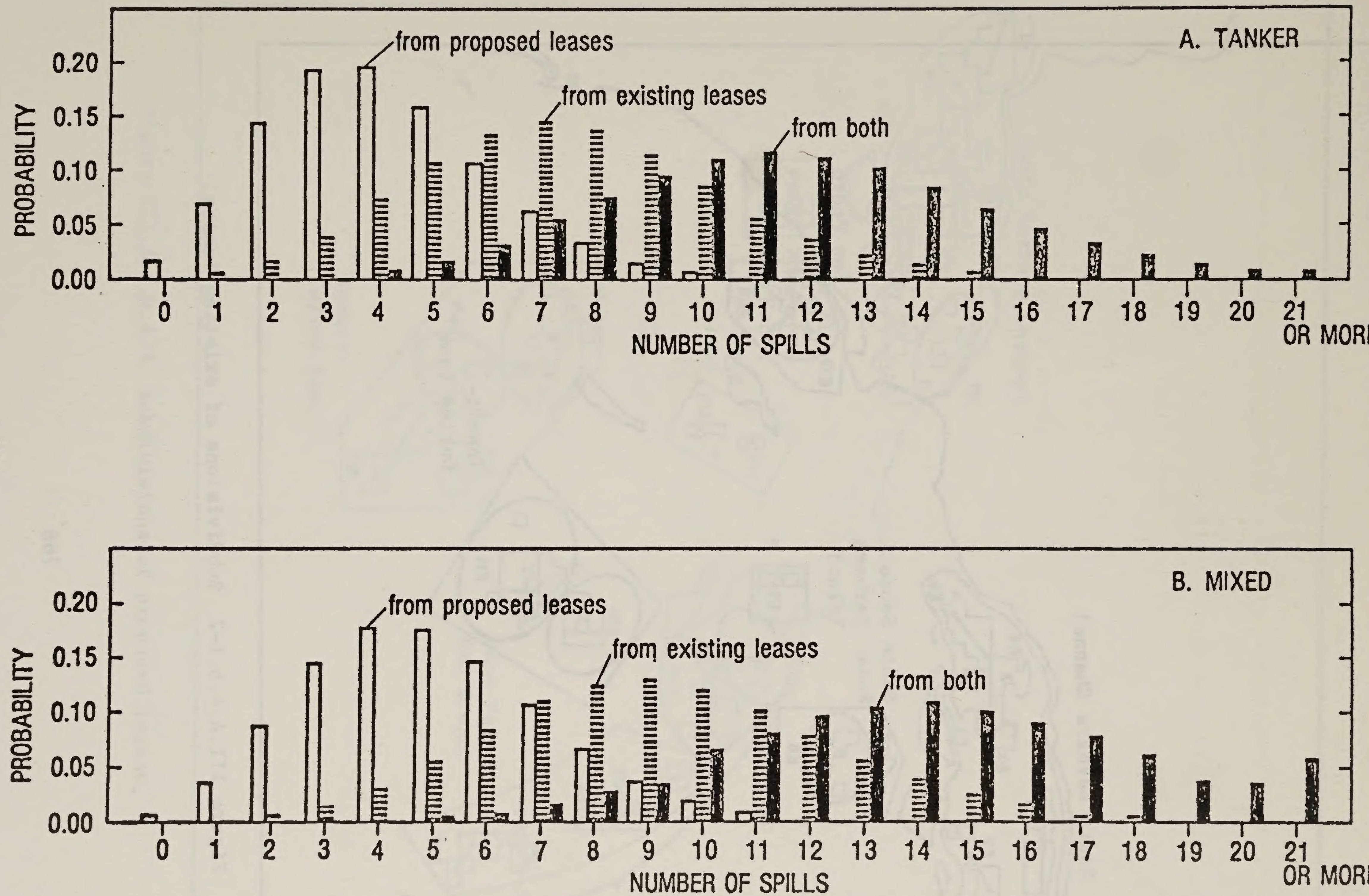


Figure III.A.4.b.i-1 --Spill frequency distributions for spills greater than 1,000 barrels during the (remaining) production lives of the lease areas.

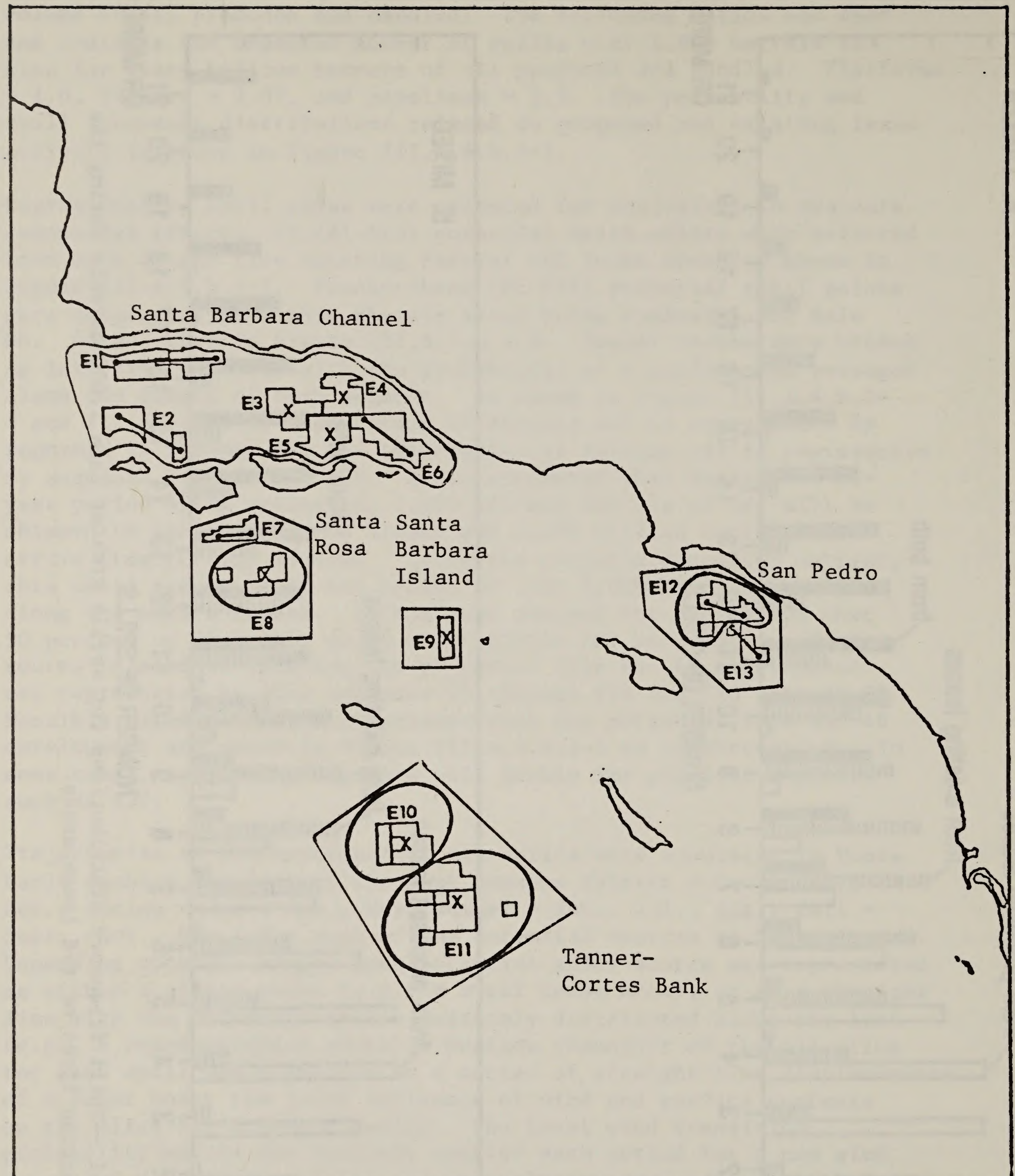


Figure III.A.4.b.i-2 Subdivisions of existing leases.

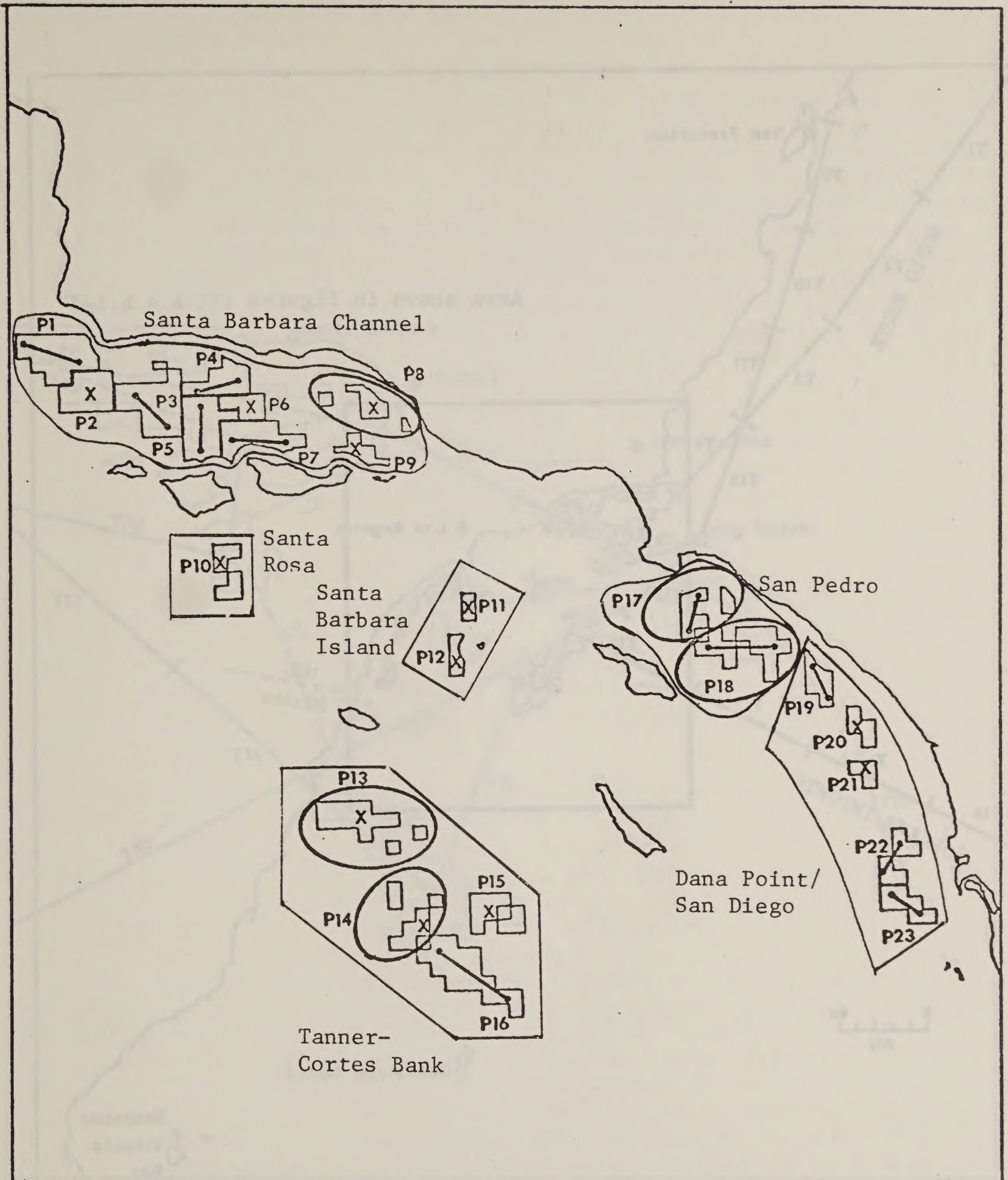


Figure III.A.4.b.i-3 Subdivisions of proposed leases.

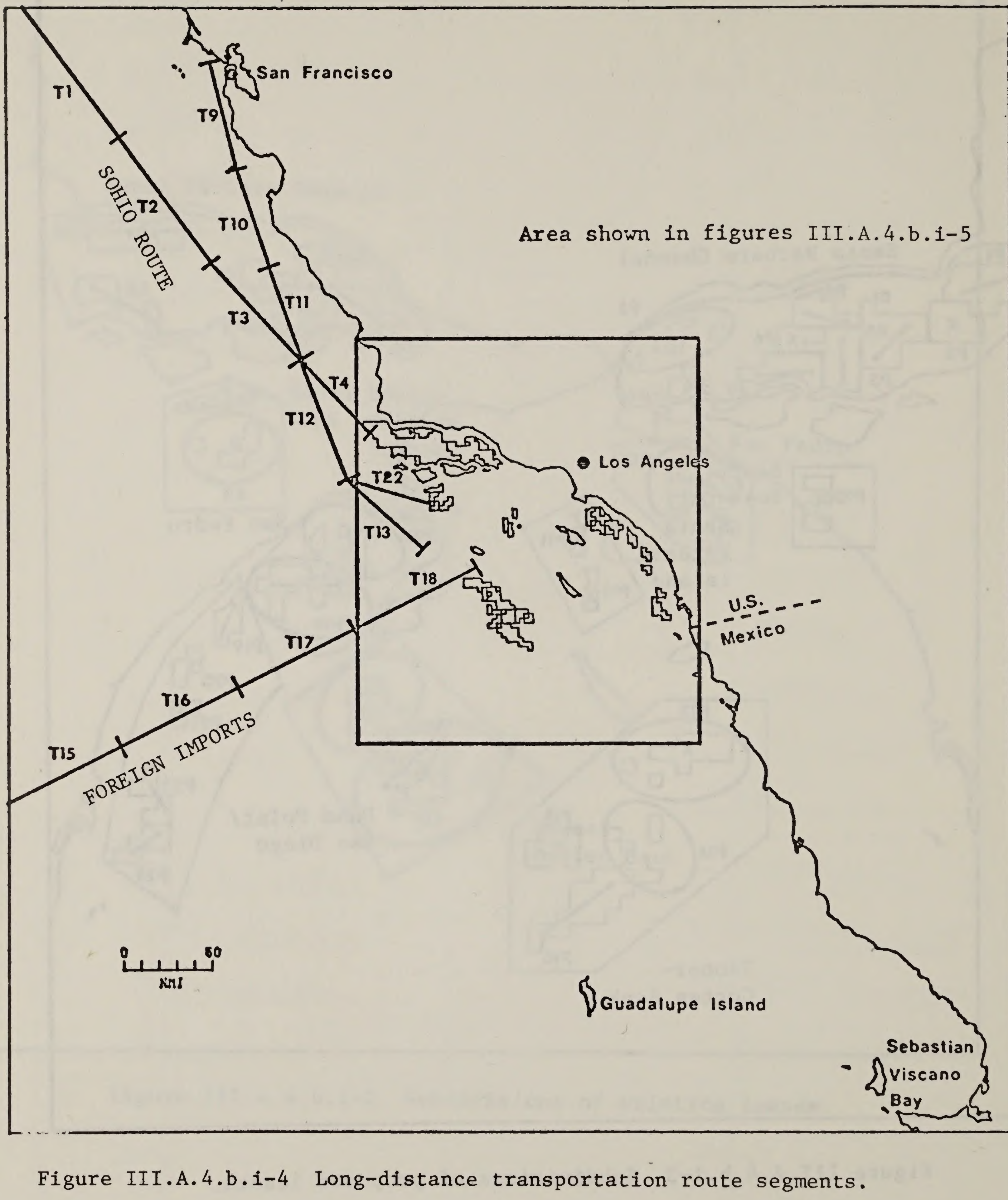


Figure III.A.4.b.i-4 Long-distance transportation route segments.

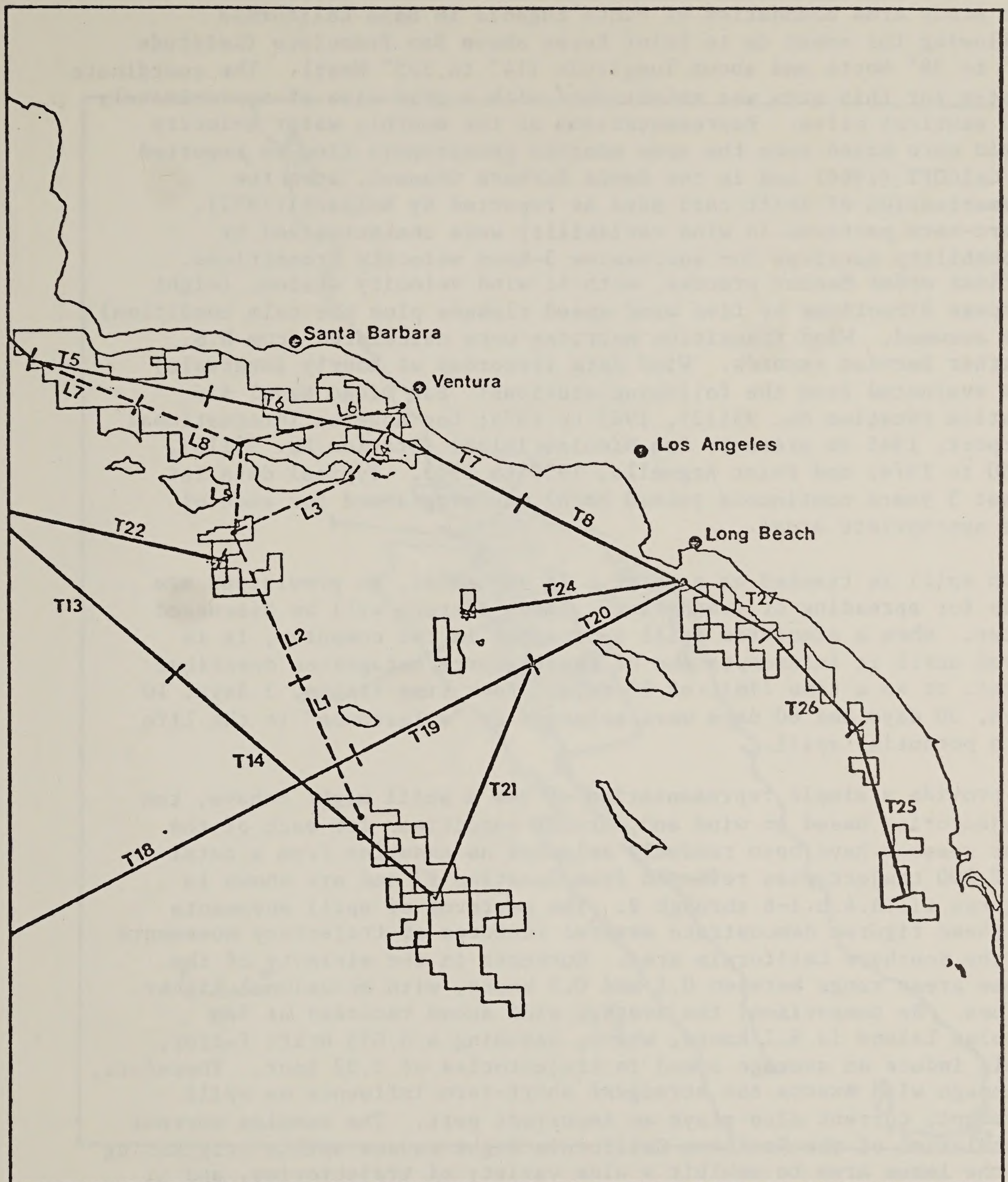


Figure III.A.4.b.i-5 Local transportation route segments.

Analysis of drift bottles records (CalCOFI, 1966) from bottles released in the Southern California Bight resulted in establishing the study area boundaries of Punta Eugenia in Baja California following the coast up to Point Reyes above San Francisco (Latitude 28° to 38° North and about longitude 114° to 125° West). The coordinate system for this area was established with a grid size of approximately 1.3 nautical miles. Representations of the monthly water velocity field were based upon the mean monthly geostrophic flow as reported in CalCOFI (1966) and in the Santa Barbara Channel, upon the summarization of drift card data as reported by Kolpack (1971). Short-term patterns in wind variability were characterized by probability matrices for successive 3-hour velocity transitions. A first order Markov process, with 41 wind velocity states, (eight compass directions by five wind speed classes plus the calm condition) was assumed. Wind transition matrices were calculated from U.S. Weather Service records. Wind data (recorded at hourly intervals) was evaluated from the following stations: San Diego Naval Air Station (Station No. 93112), 1945 to 1975; Los Angeles International Airport, 1945 to present; San Nicolas Island (Station No. 93116), 1950 to 1974; and Point Arguello, 1959 to 1965. Typical data (at least 5 years continuous record each) was programmed for each of the appropriate areas.

Each spill is tracked as a point. In the model, no provisions are made for spreading or weathering. These factors will be discussed later. When a simulated spill is started in the computer, it is moved until it intercepts one of the resource categories described later, or to a time limit of 60 days. Four time limits, 3 days, 10 days, 30 days and 60 days were selected as "milestones" in the life of a potential spill.

To provide a simple representation of how a spill might behave, ten trajectories based on wind and current conditions for each of the four seasons have been randomly selected as examples from a total of 2,000 trajectories released from location E7 and are shown in Figures III.A.4.b.i-6 through 9. The patterns of spill movements in these figures demonstrate several features of trajectory movements in the Southern California area. Currents in the vicinity of the lease areas range between 0.1 and 0.3 knots, with occasional higher values. By comparison, the average wind speed recorded at San Nicolas Island is 9.1 knots, which, assuming a 0.035 drift factor, would induce an average speed in trajectories of 0.32 knot. Therefore, although wind exerts the strongest short-term influence on spill movement, current also plays an important part. The complex current circulation of the Southern California Bight causes spills originating in the lease area to exhibit a wide variety of trajectories, and it is difficult to define a "typical" path. Once farther than 40 to 50 miles from shore, however, spills usually are driven south and southeast by the prevailing winds and currents. Because there is

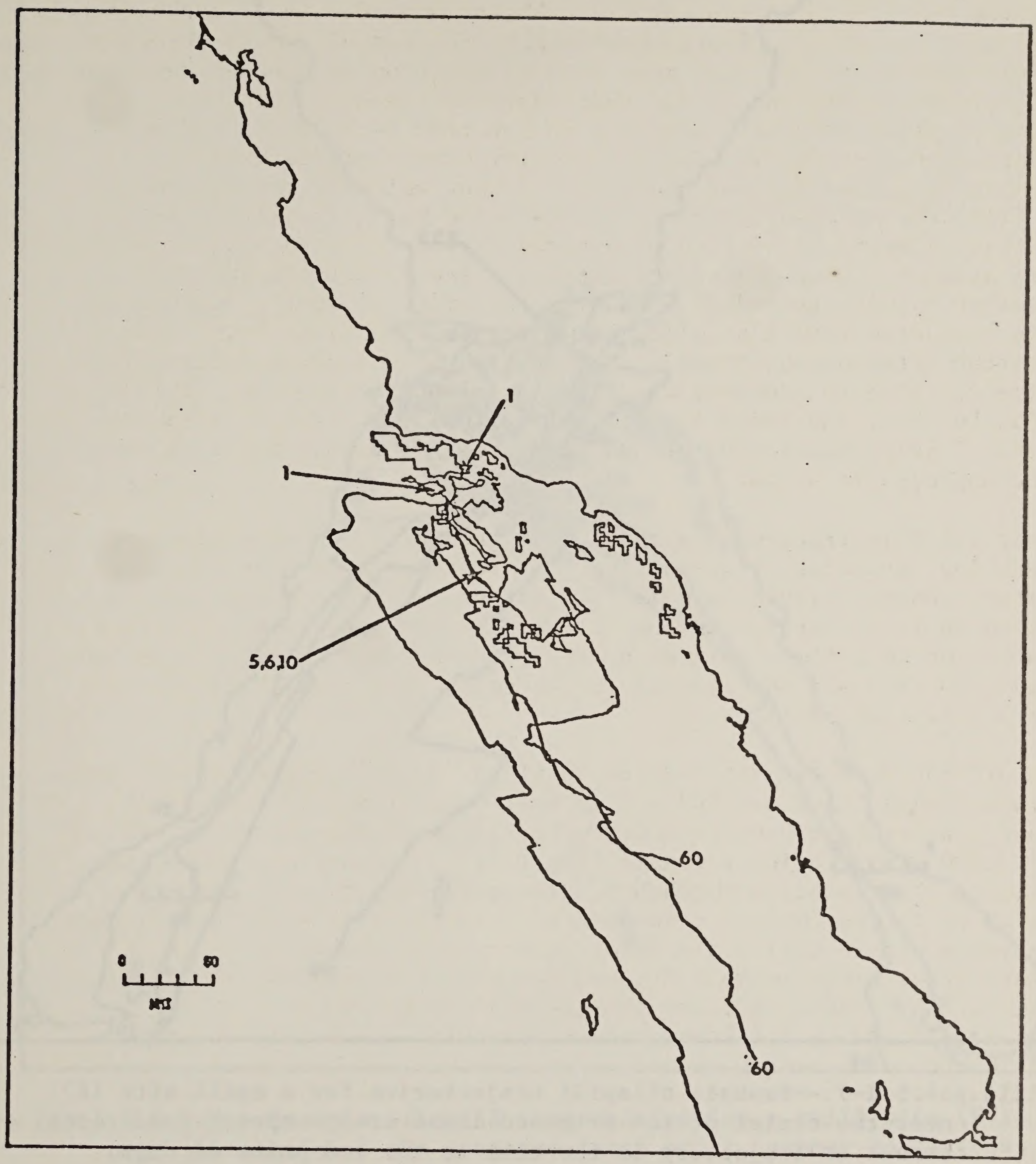


Figure III.A.4.b.i-6 --Example oilspill trajectories for a spill site (E7) near the center of the proposed lease area: winter conditions. Number on trajectory is the time to the end point in days.

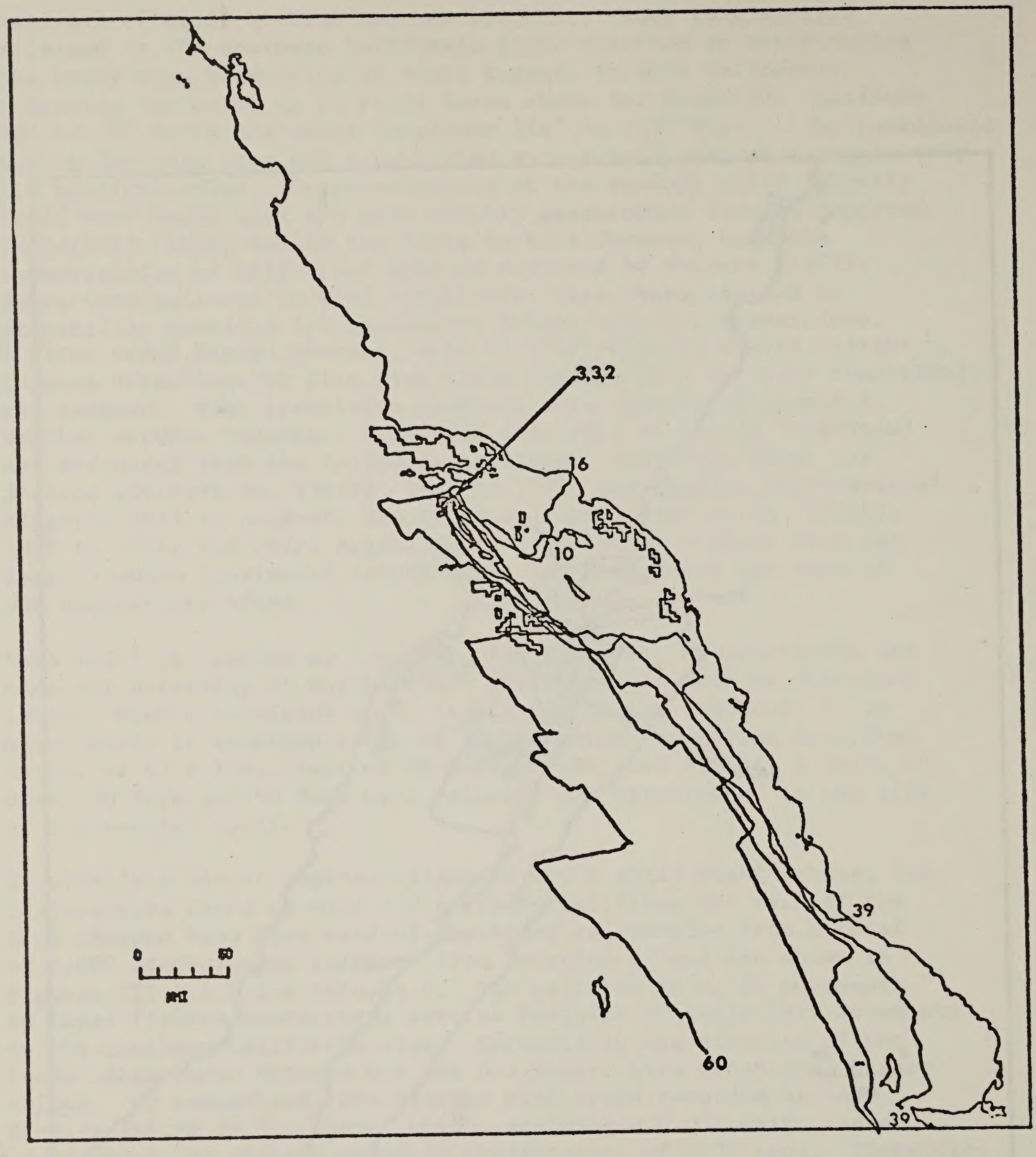


Figure III.A.4.b.i-7 --Example oilspill trajectories for a spill site (E7) near the center of the proposed lease area: spring conditions. Number on trajectory is the time to the end point in days.

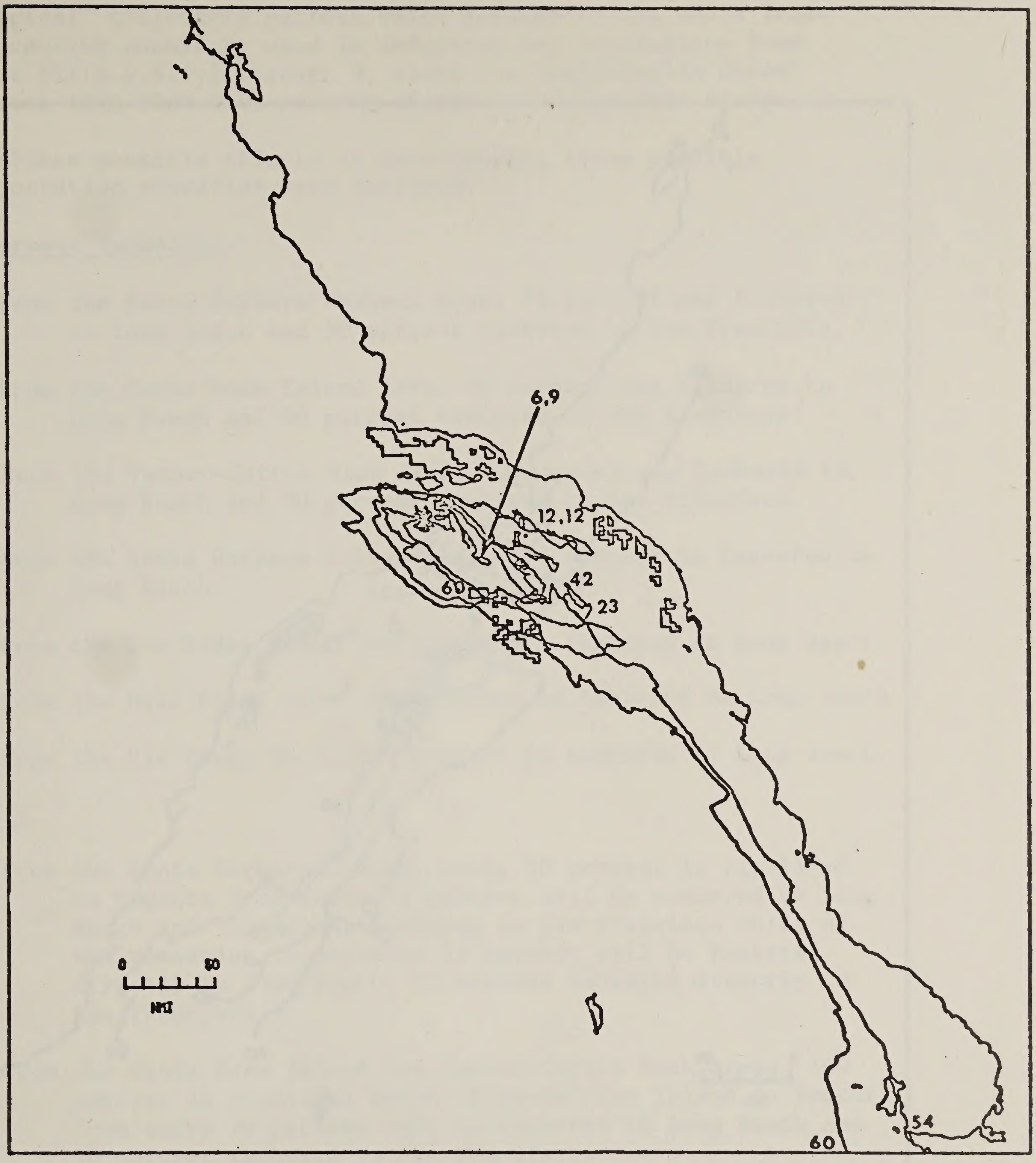


Figure III.A.4.b.i-8 --Example oilspill trajectories for a spill site (E7) near the center of the proposed lease area: summer conditions. Number on trajectory is the time to the end point in days.

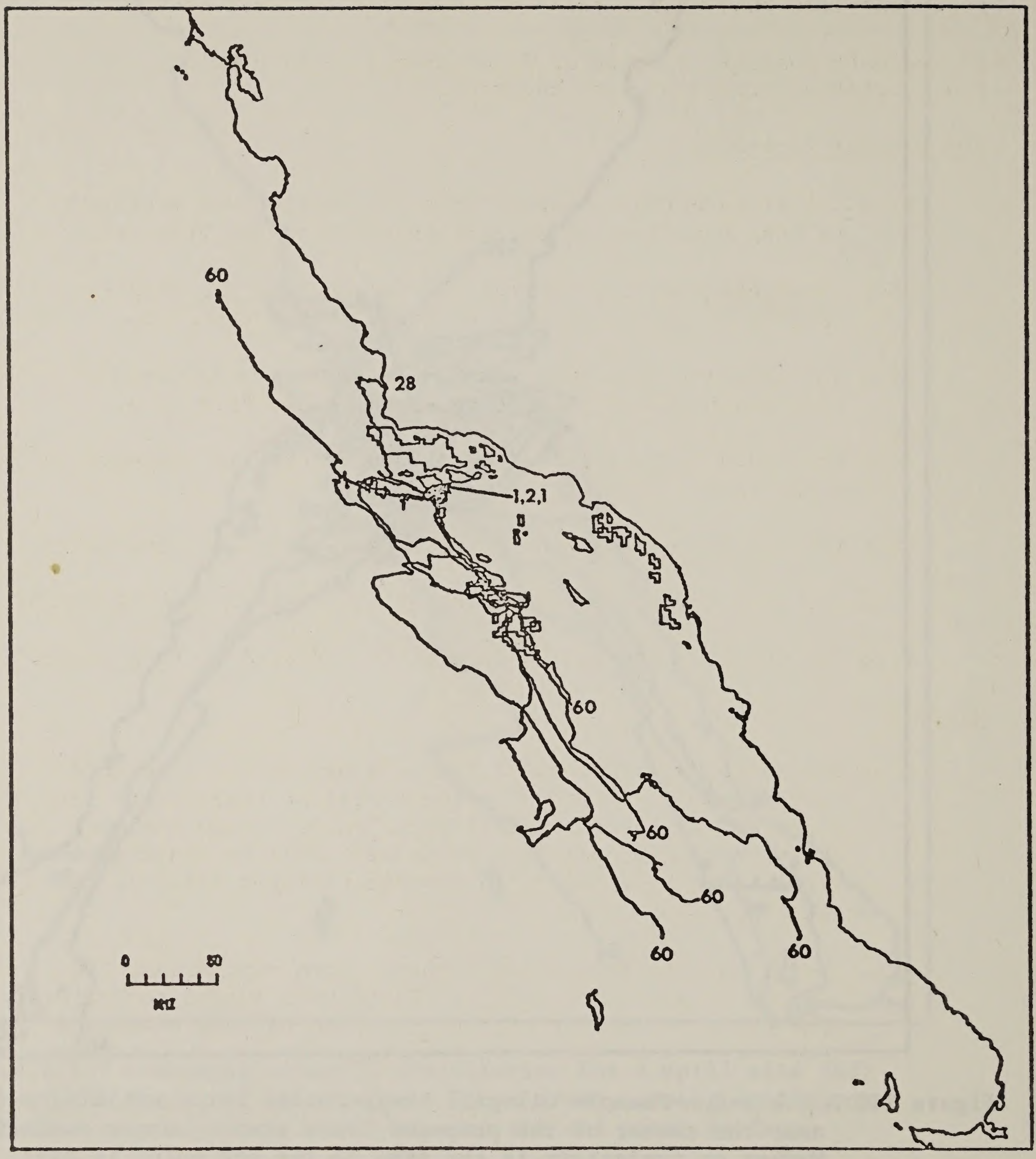


Figure III.A.4.b.i-9 --Example oilspill trajectories for a spill site (E7) near the center of the proposed lease area: autumn conditions. Number on trajectory is the time to the end point in days.

no "typical" trajectory pattern which applies to the whole lease area, caution should be used in inferring any conclusions from Figures III.A.4.b.i-6 through 9, since the trajectories shown represent less than 0.03 percent of those run for this study.

To evaluate possible effects of development, three possible transportation scenarios were analyzed:

100 Percent Tankering

From the Santa Barbara Channel Area, 70 percent was tankered to Long Beach and 30 percent tankered to San Francisco.

From the Santa Rosa Island Area, 70 percent was tankered to Long Beach and 30 percent tankered to San Francisco.

From the Tanner-Cortes Bank Area, 70 percent was tankered to Long Beach and 30 percent tankered to San Francisco.

From the Santa Barbara Island Area, 100 percent is tankered to Long Beach.

From the San Pedro Area, 100 percent is tankered to Long Beach.

From the Dana Point Area, 100 percent is tankered to Long Beach.

From the San Diego Area, 100 percent is tankered to Long Beach.

Mixed A

From the Santa Barbara Channel Area, 50 percent is pipelined to Ventura from where 35 percent will be tankered to Long Beach and 15 percent tankered to San Francisco while of the remaining 50 percent, 35 percent will be tankered directly to Long Beach, 15 percent tankered directly to San Francisco.

From the Santa Rosa Island and Tanner-Cortes Bank Areas, 100 percent is pipelined north of Santa Cruz Island to Ventura from where 70 percent will be tankered to Long Beach and 30 percent tankered to San Francisco.

From the San Pedro Area, 100 percent will be pipelined to Long Beach.

From the Santa Barbara Island Area, Dana Point Area and San Diego Area, 100 percent will be tankered to Long Beach.

Mixed B

Exactly the same as Mixed A, however, from the Santa Rosa Island and Tanker-Cortes areas, the pipeline will run south of Santa Cruz rather than to the north of it.

As an oil spill moves over the open sea, there is the possibility that it can come in contact with various sensitive areas or resources and keep moving. These areas are listed below along with the Figure number which shows their areal extent. In some cases, the sensitivity is only during certain parts of the year in which case the critical months are shown:

Banks	
1. Tanner-Cortes Banks	- Figure III.A.4.b.i-10
2. Ranger Bank	- Figure III.A.4.b.i-11
Commercial fishing	
3. Major marketfish	- Figure III.A.4.b.i-12
4. Major commercial pelagic fish	- Figure III.A.4.b.i-13
5. Salmon (Jun - Aug)	- Figure III.A.4.b.i-14
6. Albacore (Jun - Nov)	- Figure III.A.4.b.i-15
7. Bonito (Jun - Nov)	- Figure III.A.4.b.i-16
8. Tuna (Jun - Aug)	- Figure III.A.4.b.i-17
9. Swordfish (Sep - Nov)	- Figure III.A.4.b.i-18
10. Commercial shellfish	- Figure III.A.4.b.i-19
Seabirds	
11. Seabirds (Apr - Jun)	- Figure III.A.4.b.i-20
12. Seabirds (Jul - Sep)	- Figure III.A.4.b.i-21
13. Seabirds (Oct - Dec)	- Figure III.A.4.b.i-22
14. Seabirds (Jan - Mar)	- Figure III.A.4.b.i-23
Sportfishing	
15. Rockfish, kelp bass, sea bass, barracuda and bonito	- Figure III.A.4.b.i-24
16. Striped-marlin, swordfish, bluefin tuna and albacore (Jul - Oct)	- Figure III.A.4.b.i-25
17. Salmon (Mar - Aug)	- Figure III.A.4.b.i-26

To determine potential oil spill impact on shore, the shore line was divided into 60 segments of equal length as shown in Figure III.A.4.b.i-27. Each applicable shoreline segment was then in turn evaluated for appropriate resource categories as shown in Table III.A.4.b-1.

ii. Fate of Oil in the Marine Environment (Weathering): Crude oil contains tens of thousands of chemicals. Most are hydrocarbons; molecules composed of carbon and hydrogen atoms arranged in a variety of chemical structures. The molecular weight of these hydrocarbons varies from methane, which is composed

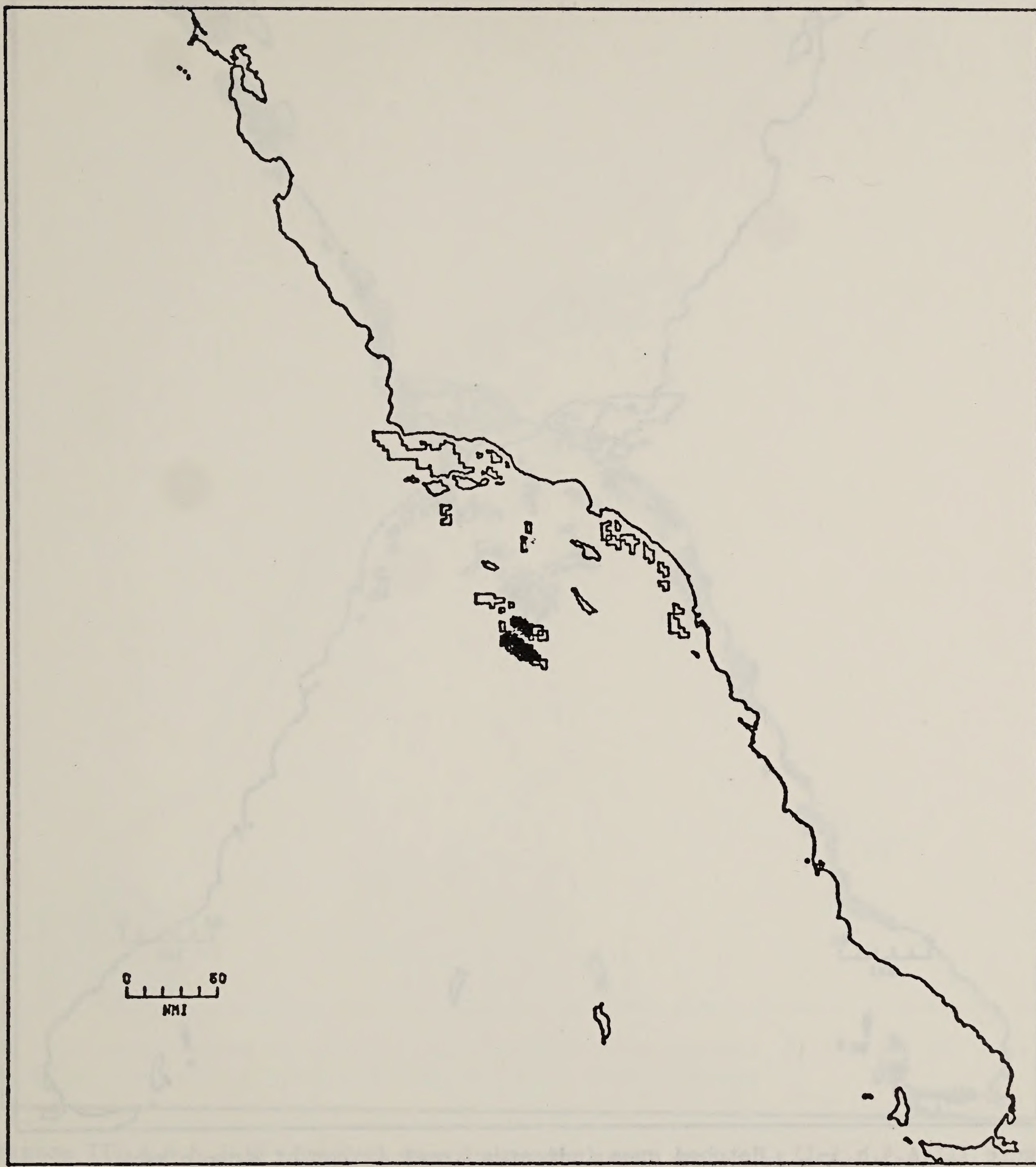


Figure III.A.4.b.i-10 Hatched area indicates areal extent of Tanner and Cortes Banks.

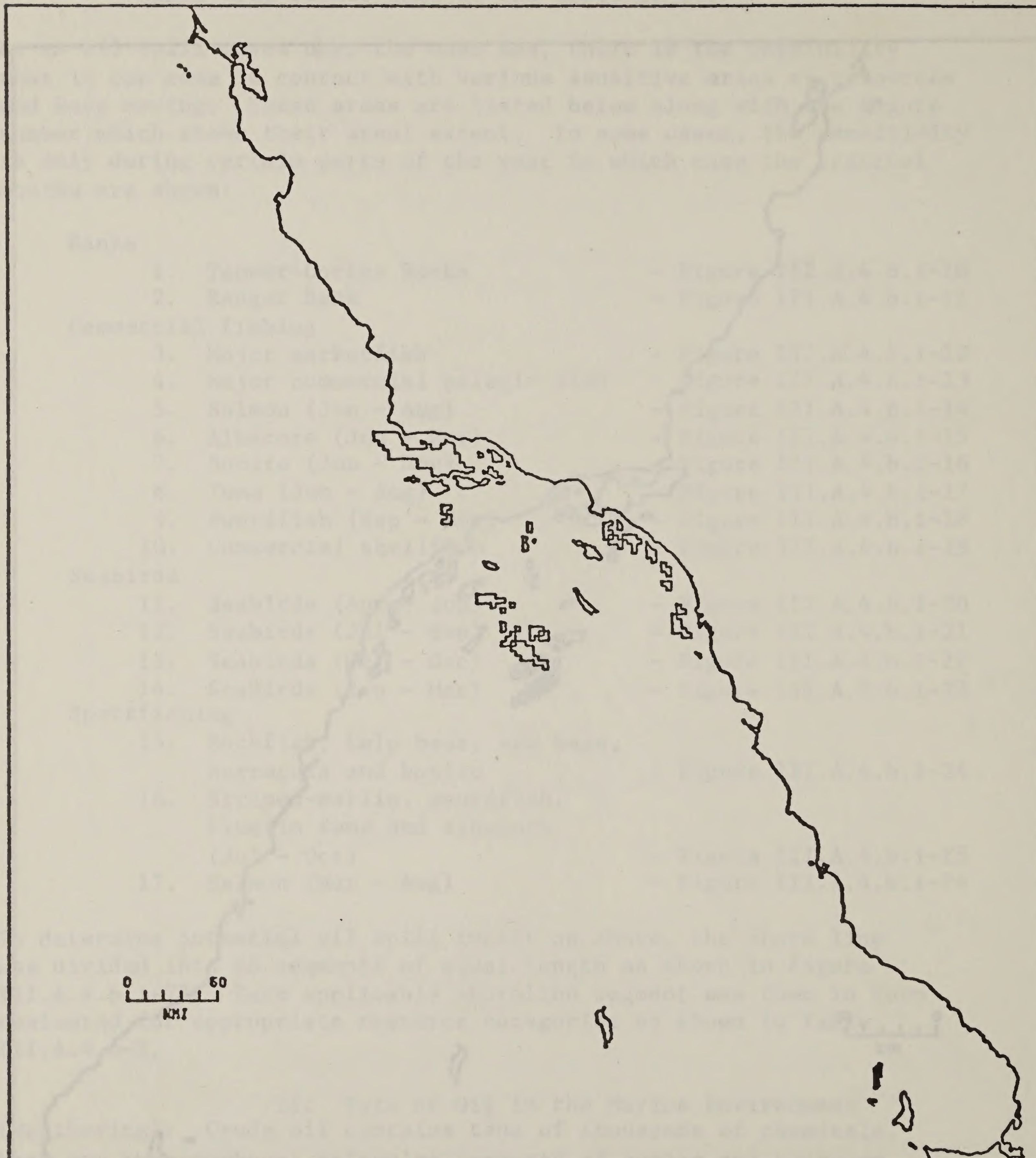


Figure III.A.4.b.i-11 Hatched area indicates areal extent of Ranger Bank.

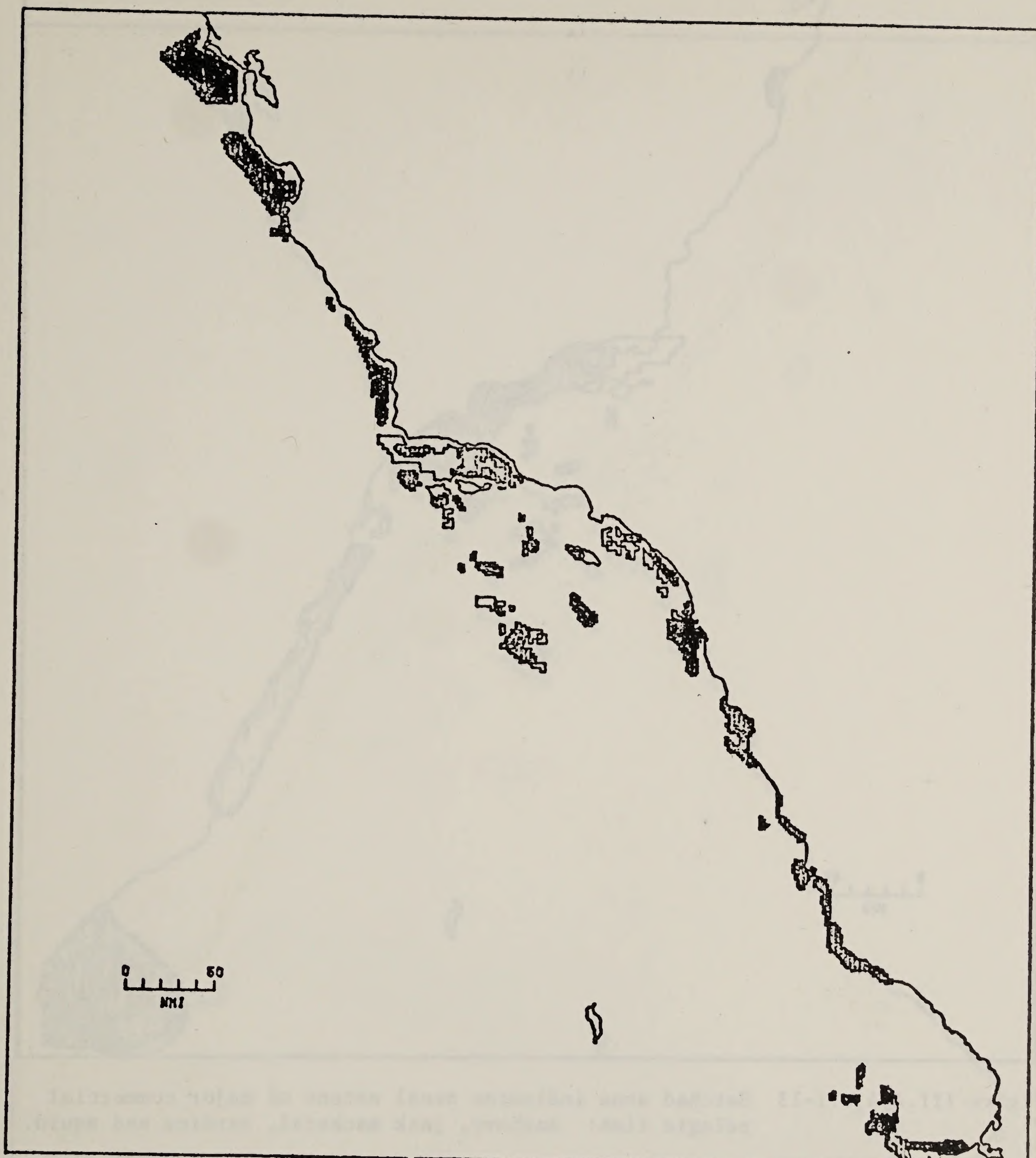


Figure III.A.4.b.1-12 Hatched area indicates areal extent of major marketfish: Rockfish, flatfish, sablefish, white sea bass, and lingcod.

Figure III.A.4.b.i-13 Hatched area indicates areal extent of major commercial pelagic fish: Anchovy, jack mackeral, sardine and squid.

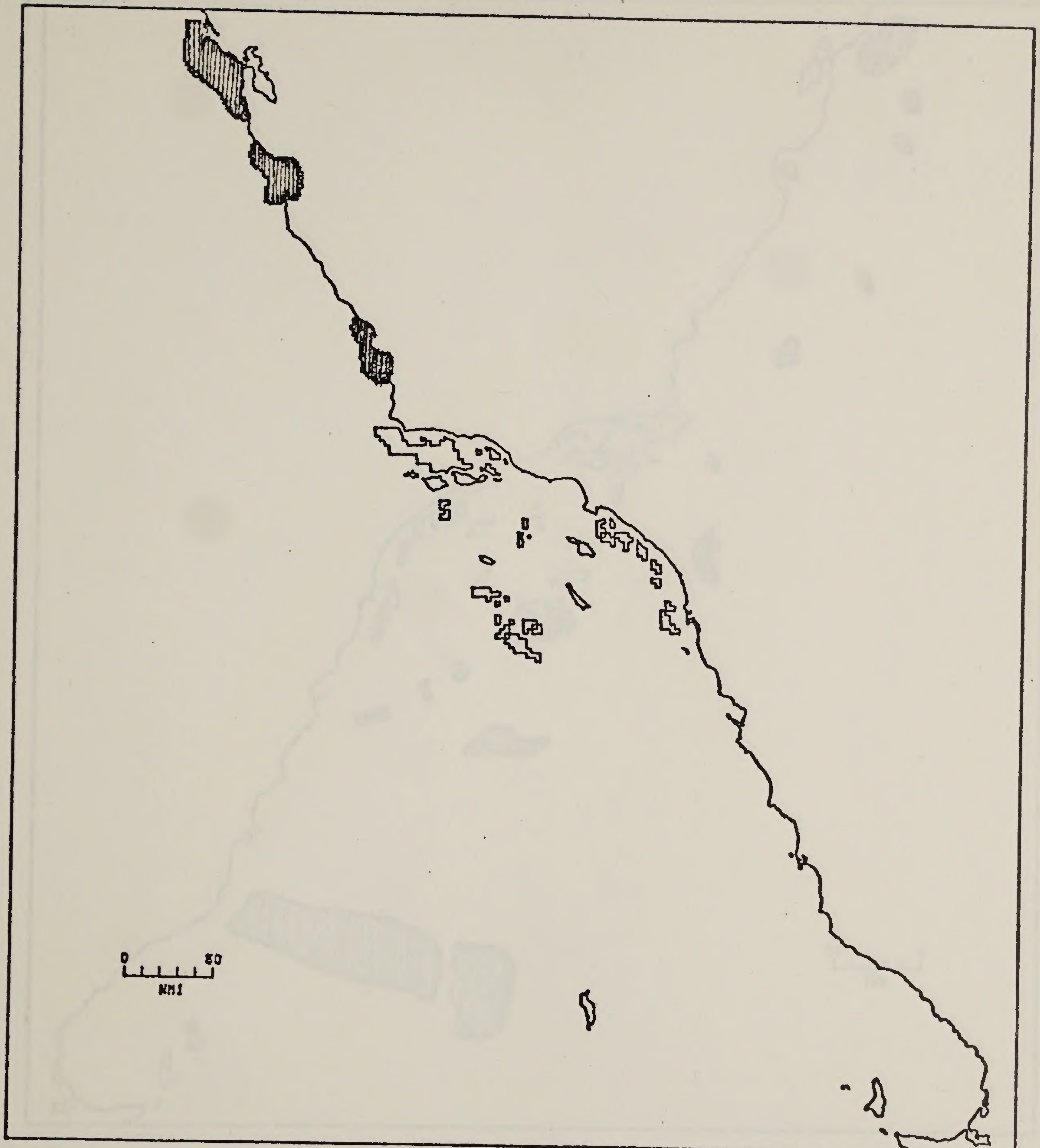


Figure III.A.4.b.i-14 Hatched area indicates areal extent of commercial salmon.

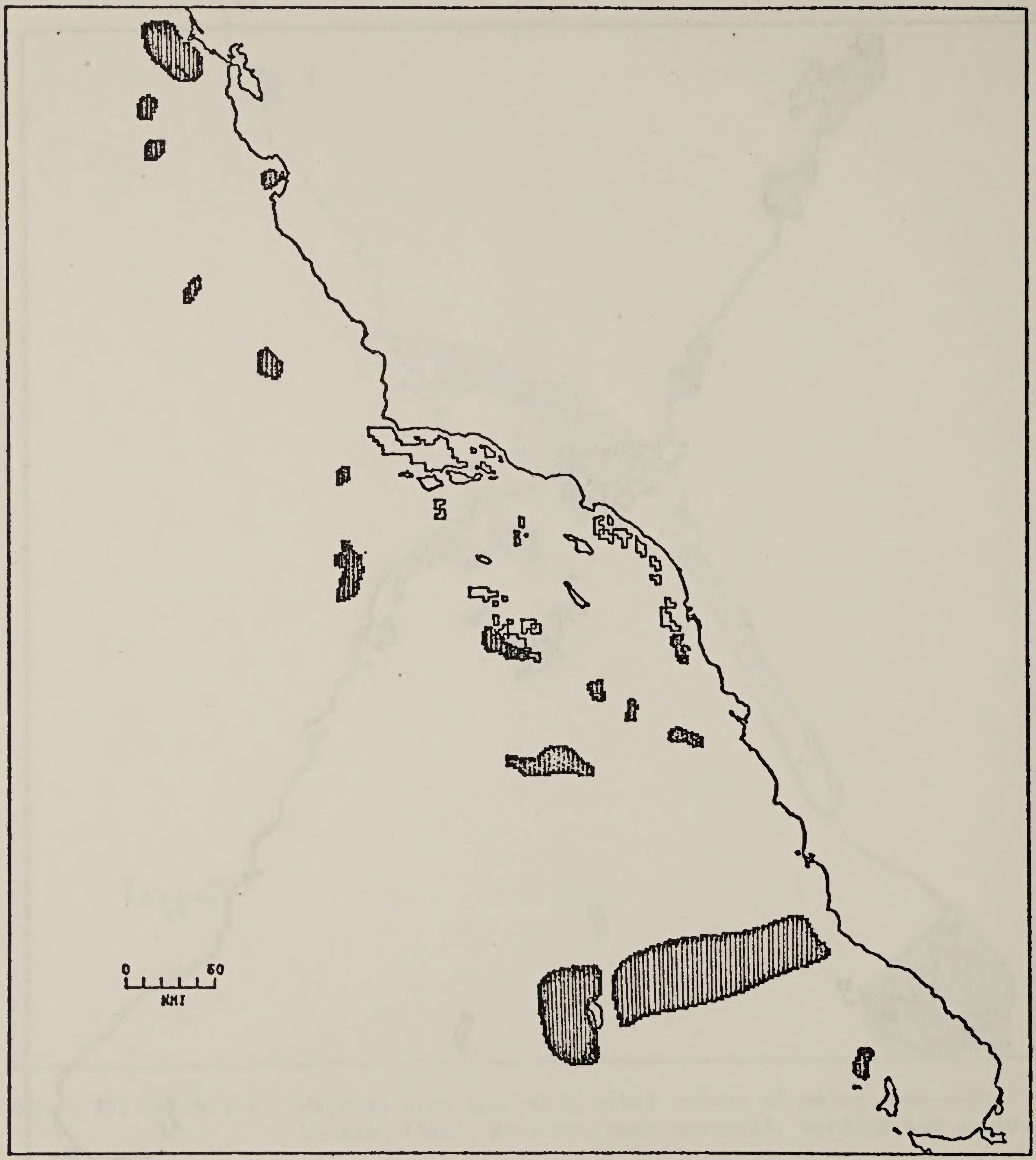


Figure III.A.4.b.i-15 Hatched area indicates areal extent of commercial albacore.

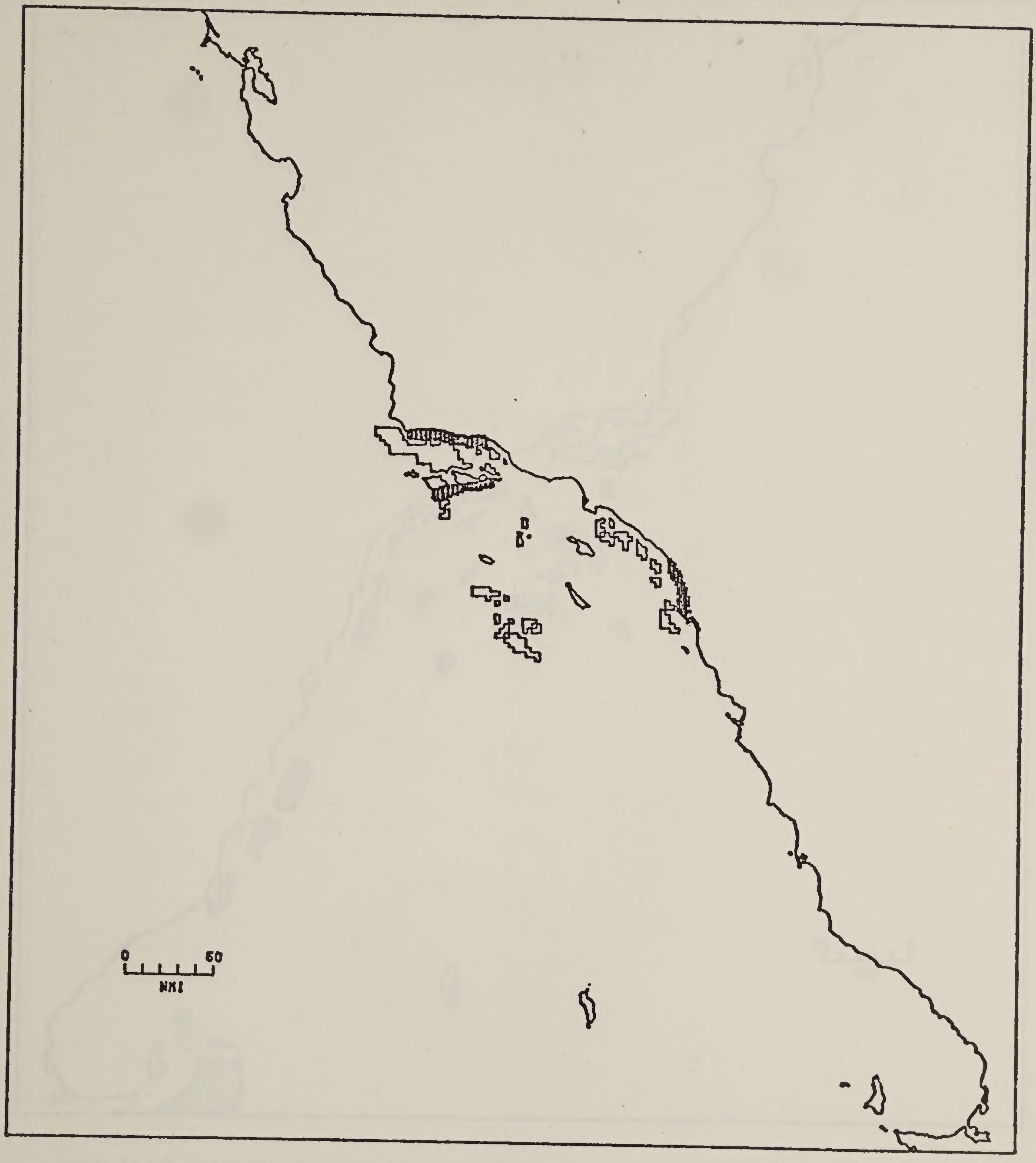


Figure III.A.4.b.i-16 Hatched area indicates areal extent of commercial bonito.

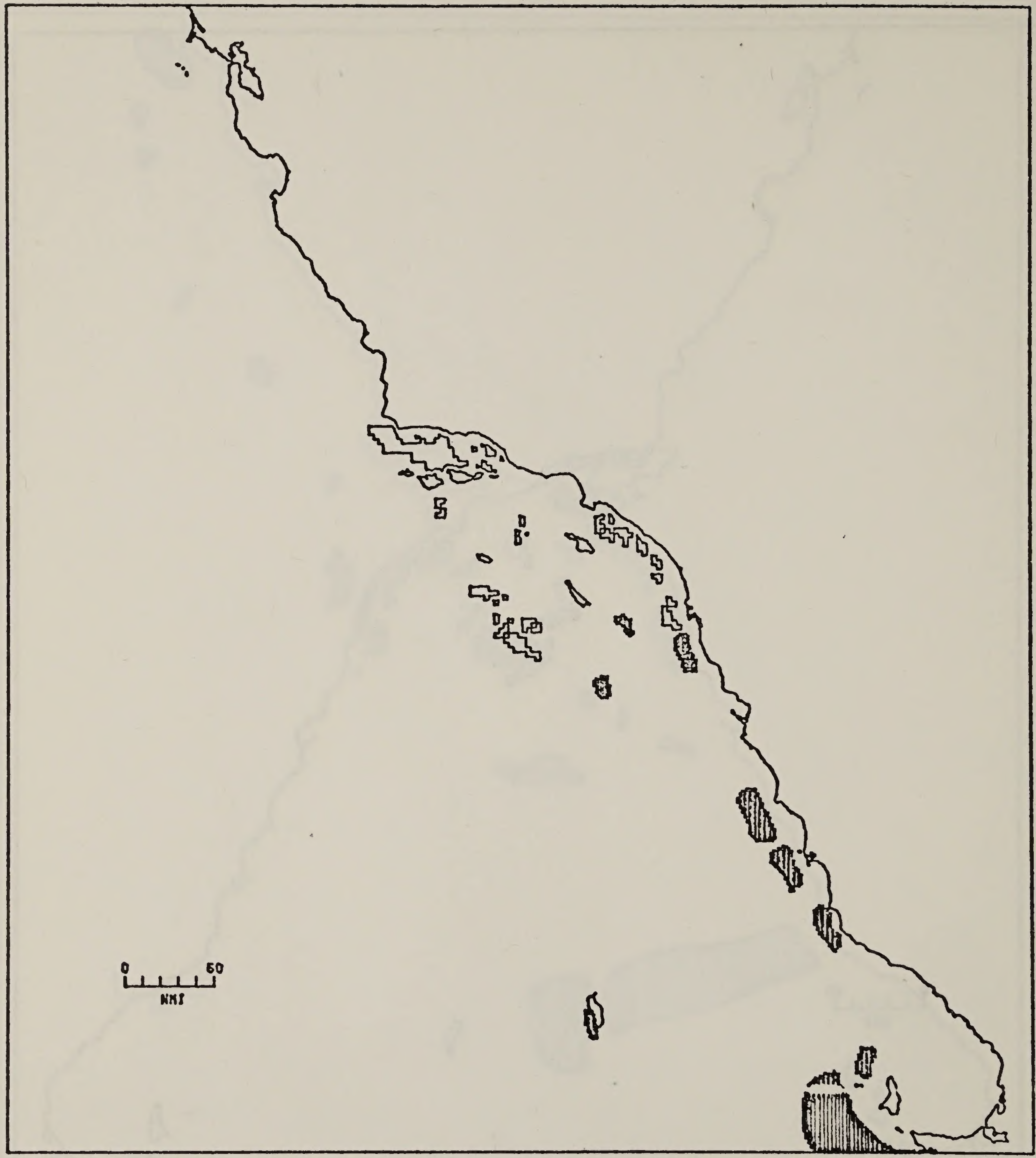


Figure III.A.4.b.i-17 Hatched area indicates areal extent of commercial tuna.

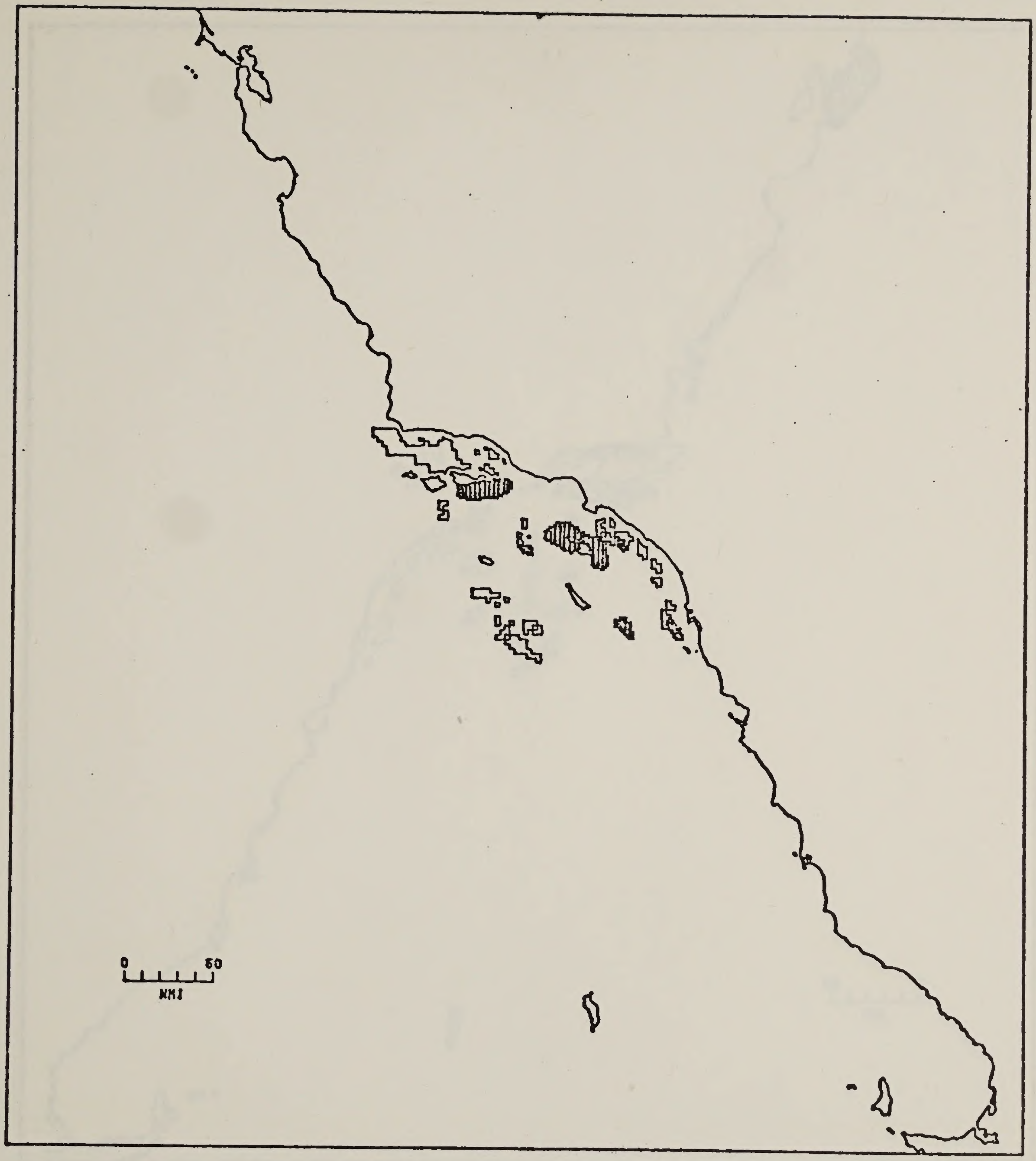


Figure III.A.4.b.i-18 Hatched area indicates areal extent of commercial swordfish.

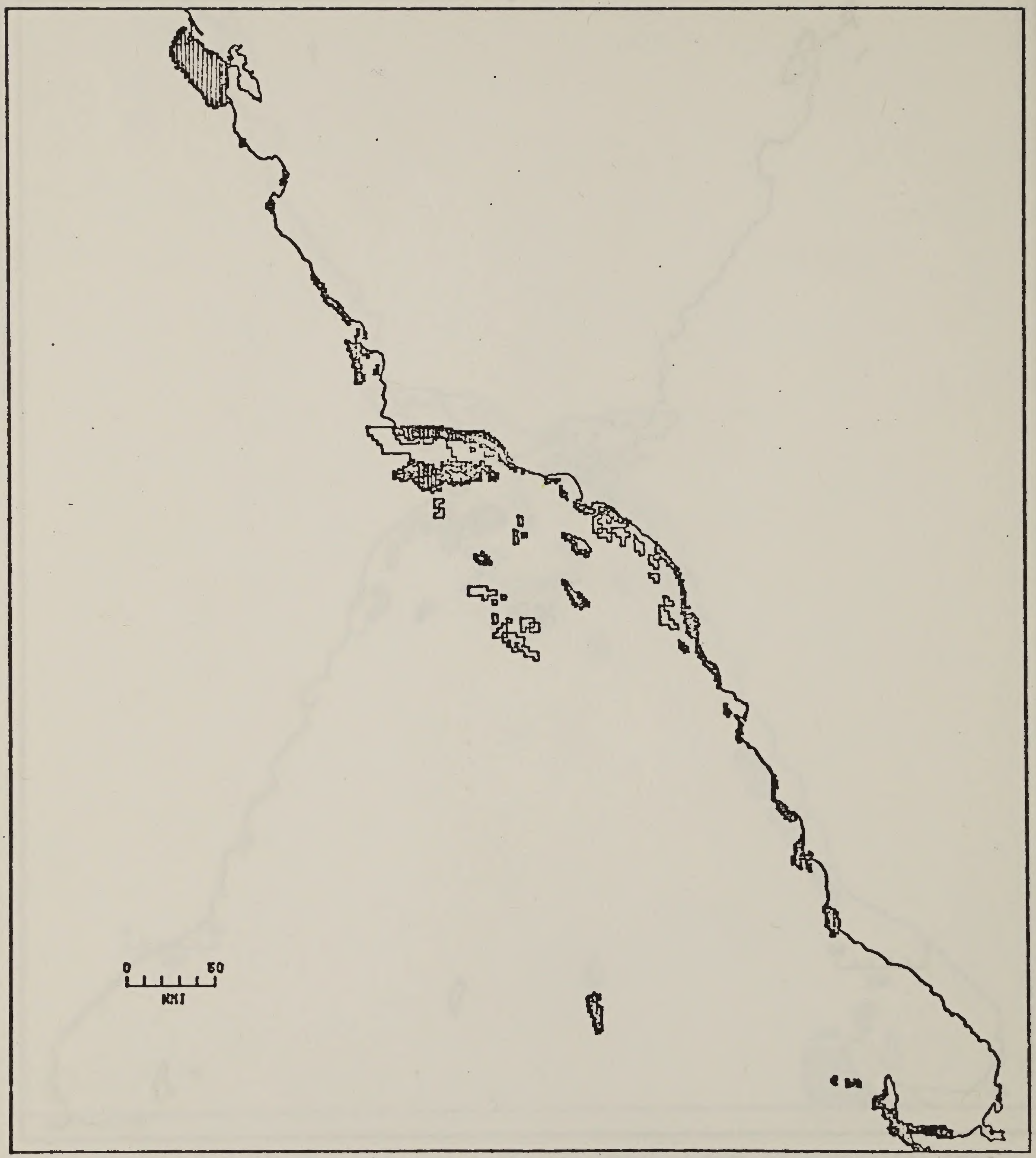


Figure III.A.4.b.i-19 Hatched area indicates areal extent of commercial shellfish.

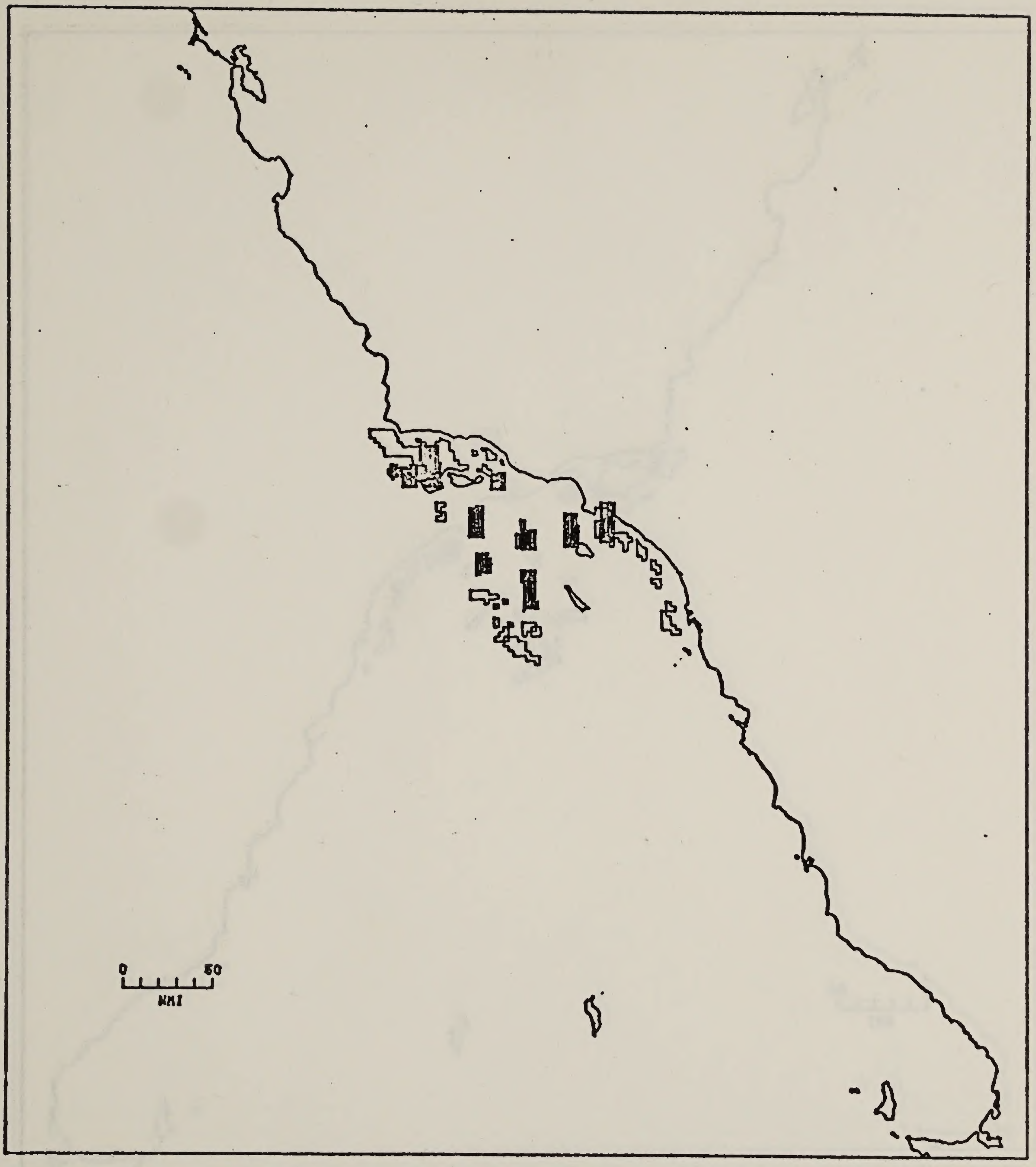


Figure III.A.4.b.i-20 Hatched area indicates areal extent of seabirds (April-June).

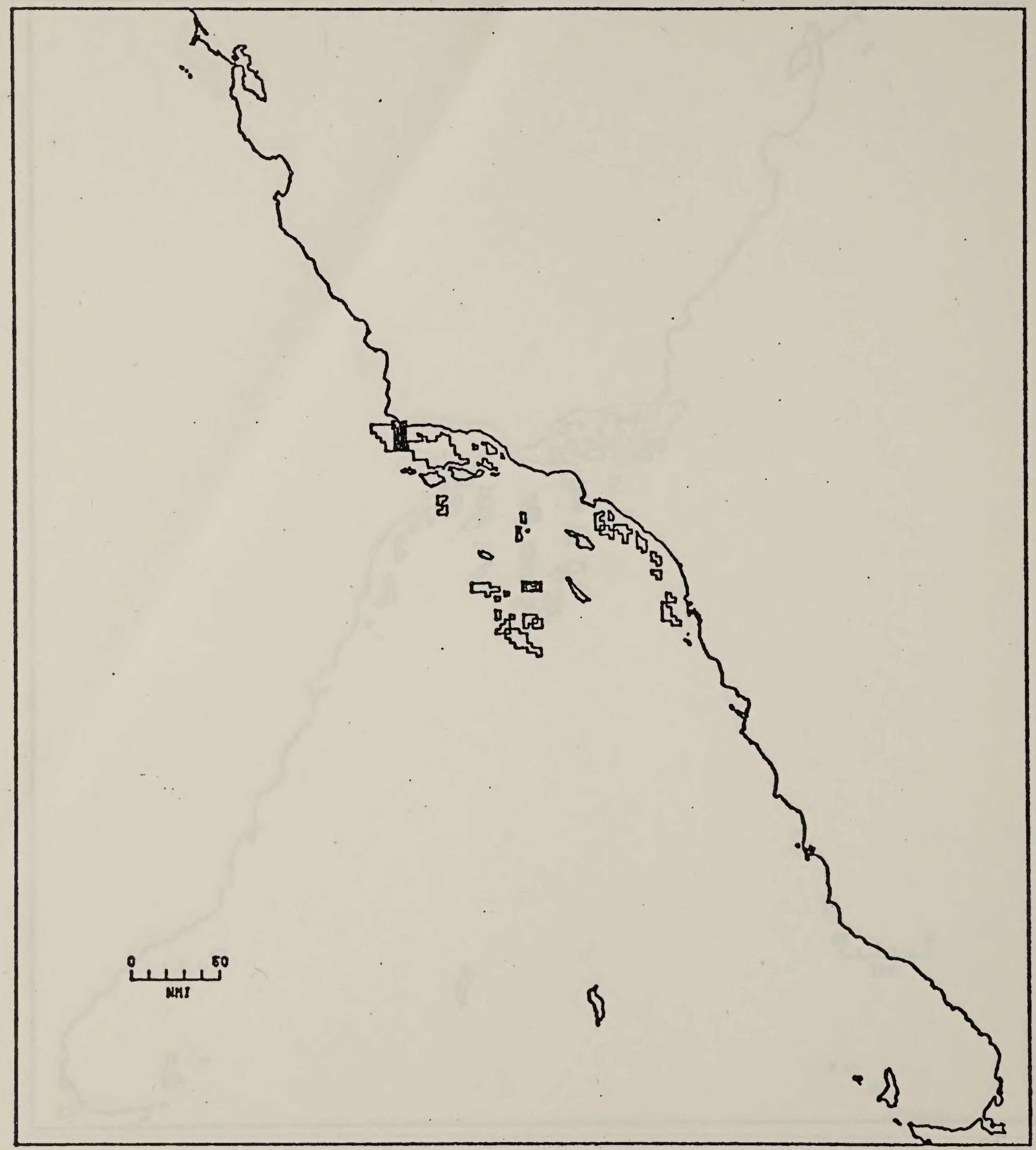


Figure III.A.4.b.i-21 Hatched area indicates areal extent of seabirds (July-Sept.).

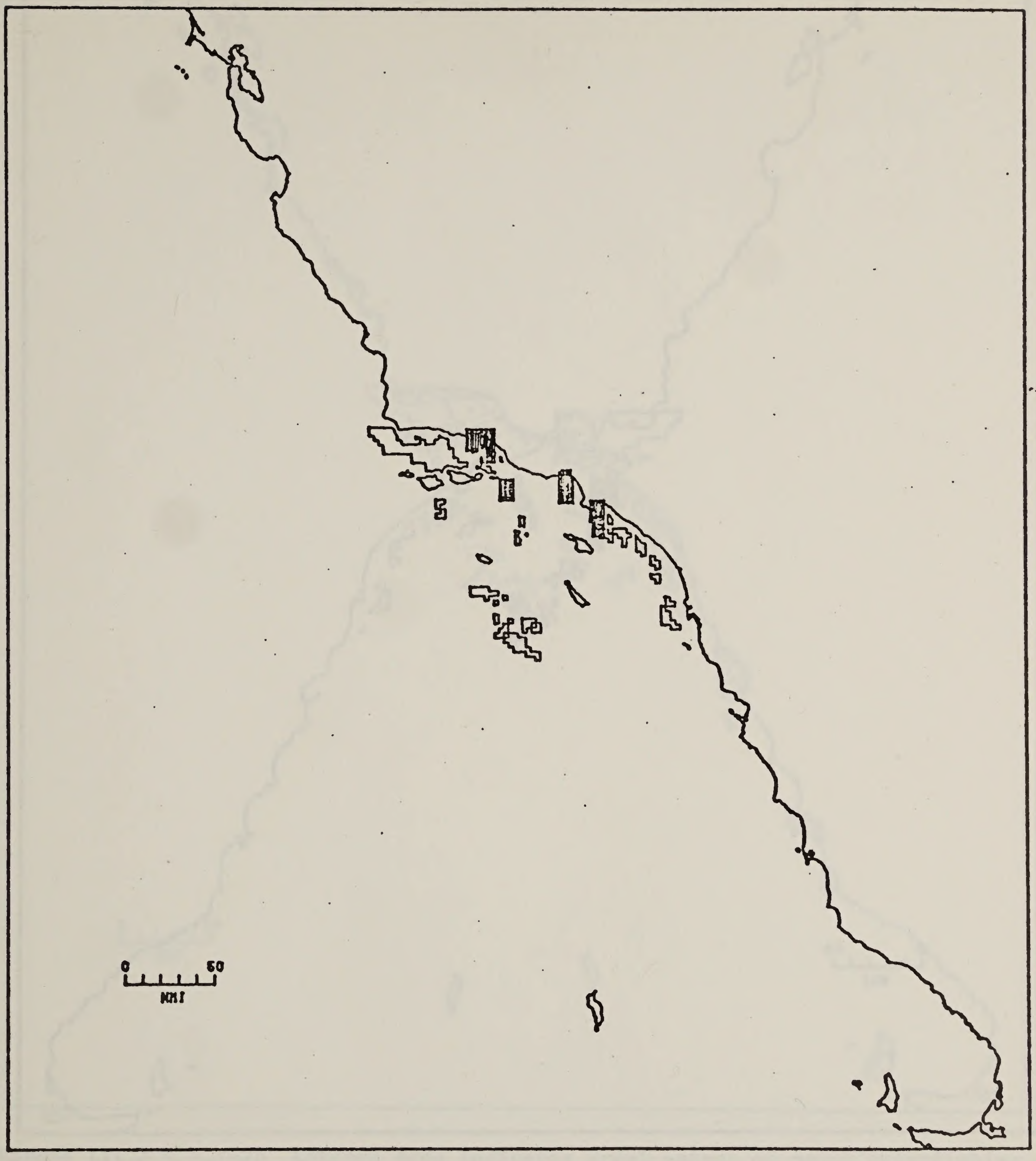


Figure IIIA.4.b.i-22 Hatched area indicates areal extent of seabirds (Oct.-Dec.).

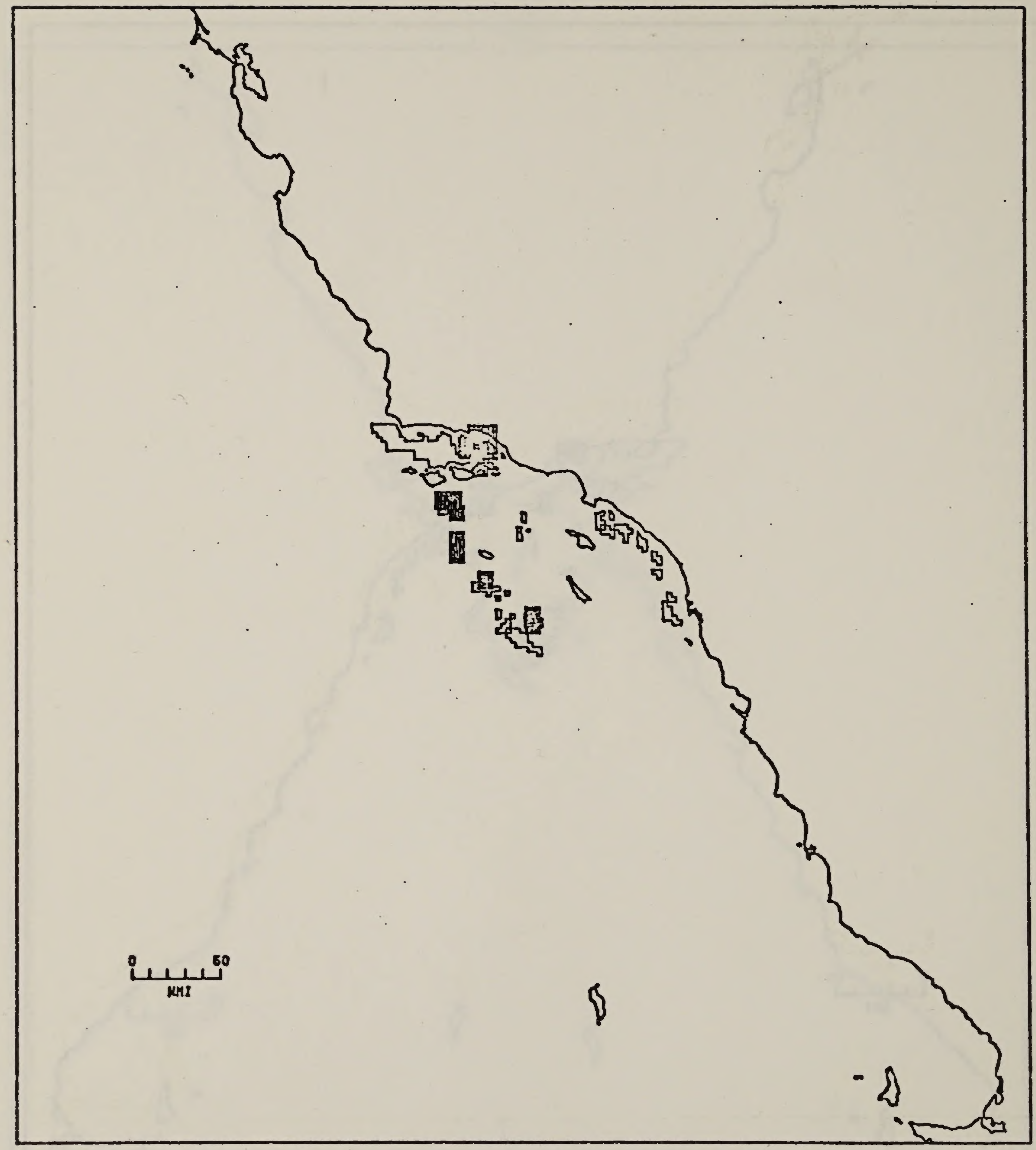


Figure III.A.4.b.i-23 Hatched area indicates areal extent of seabirds (Jan.-Mar.).

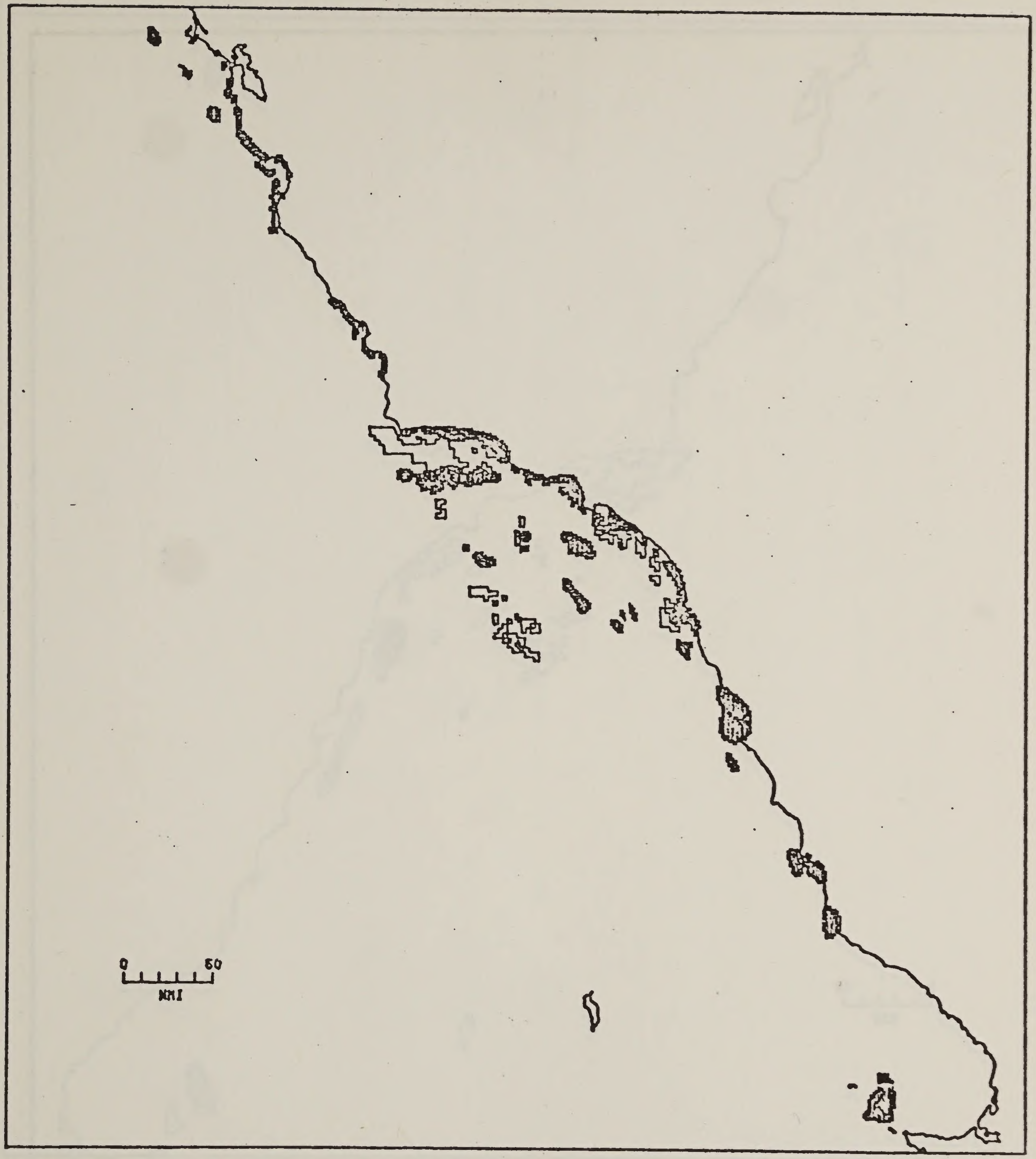


Figure III.A.4.b.i-24 Hatched area indicates areal extent of major sportfishing Grounds: Rockfish, kelp bass, barracuda and bonito.

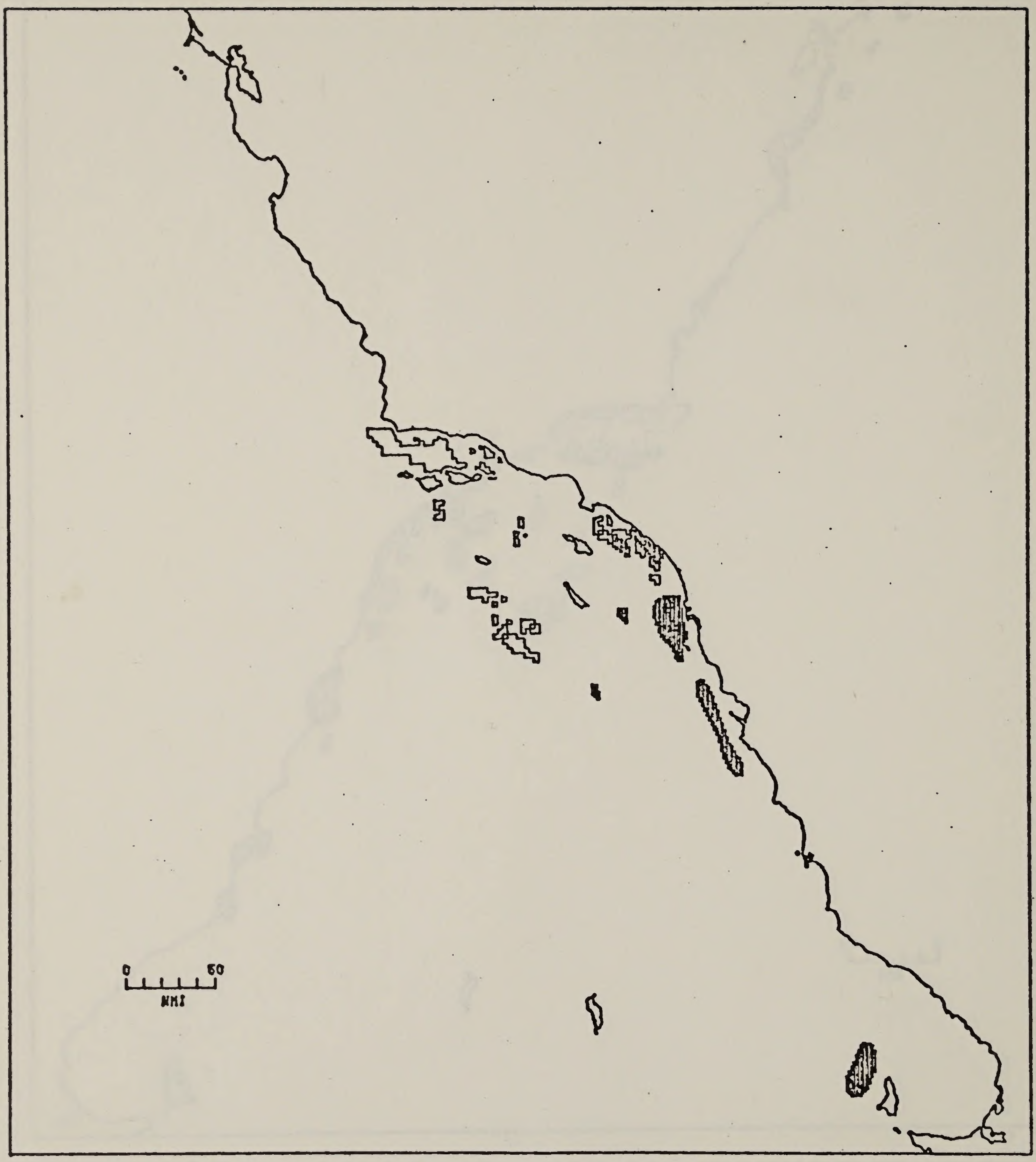


Figure III.A.4.b.i-25 Hatched area indicates areal extent of striped marlin, swordfish, bluefin tuna, and albacore (sportfishing).

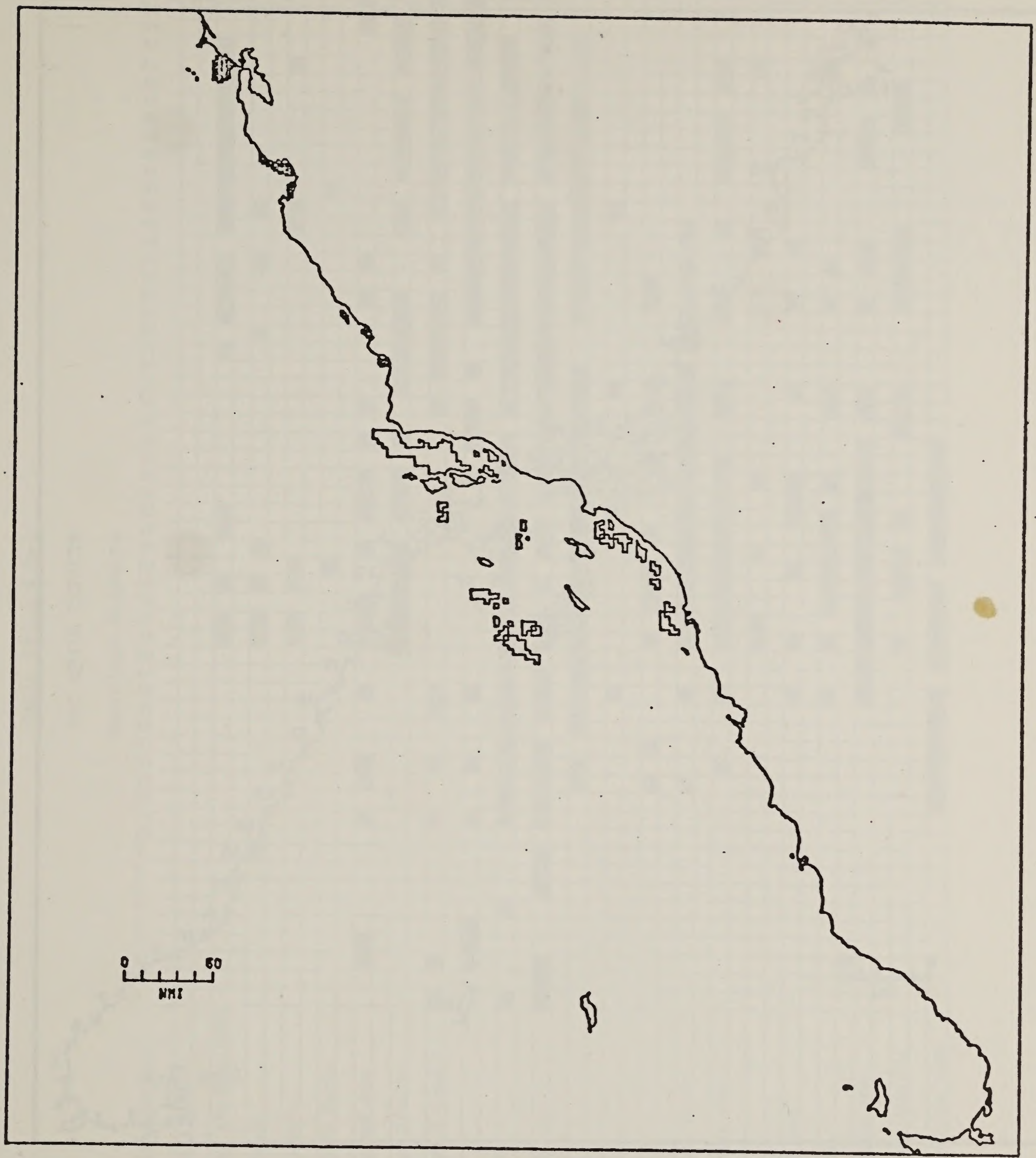


Figure III.A.4.b.i-26 Hatched area indicates areal extent of salmon (sportfishing).

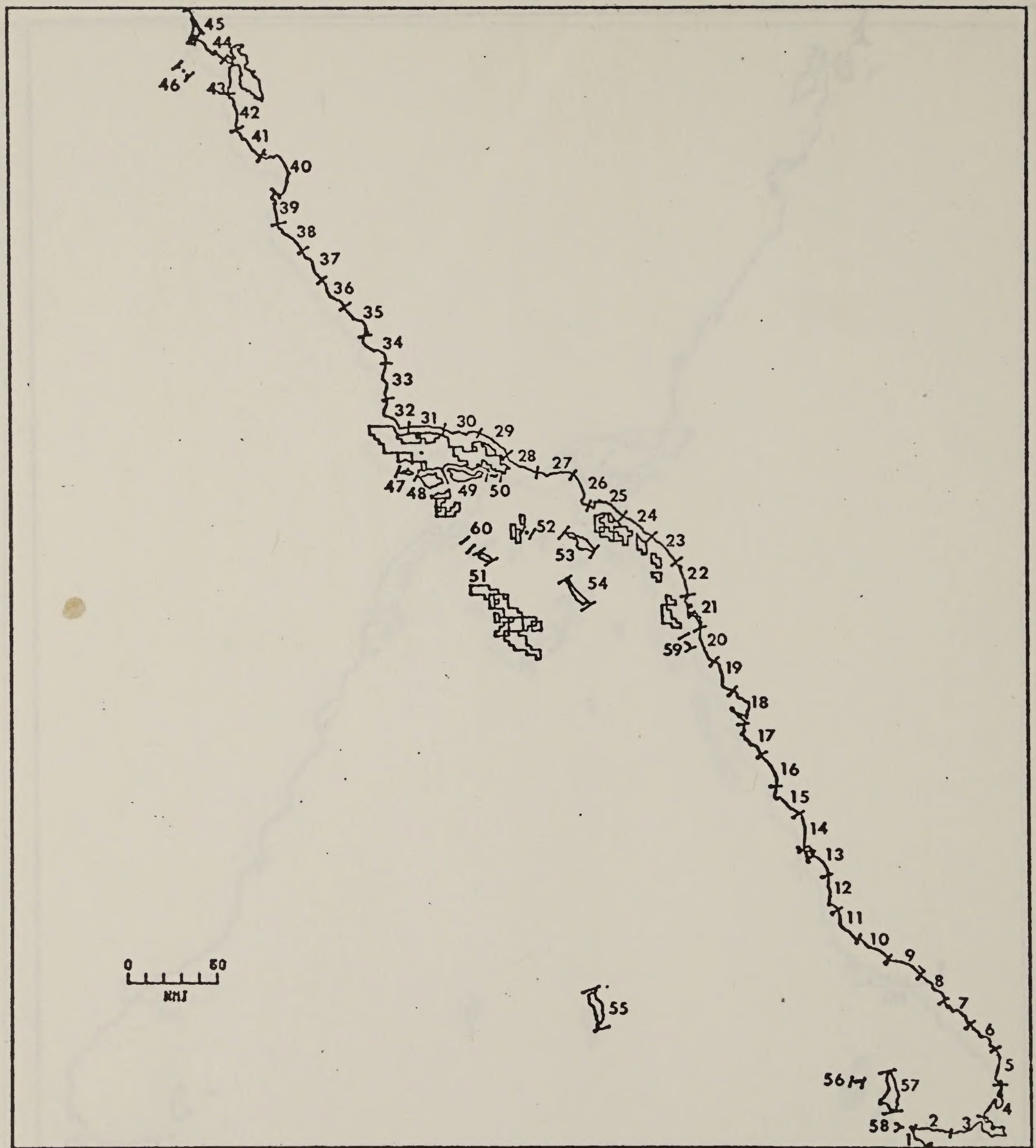
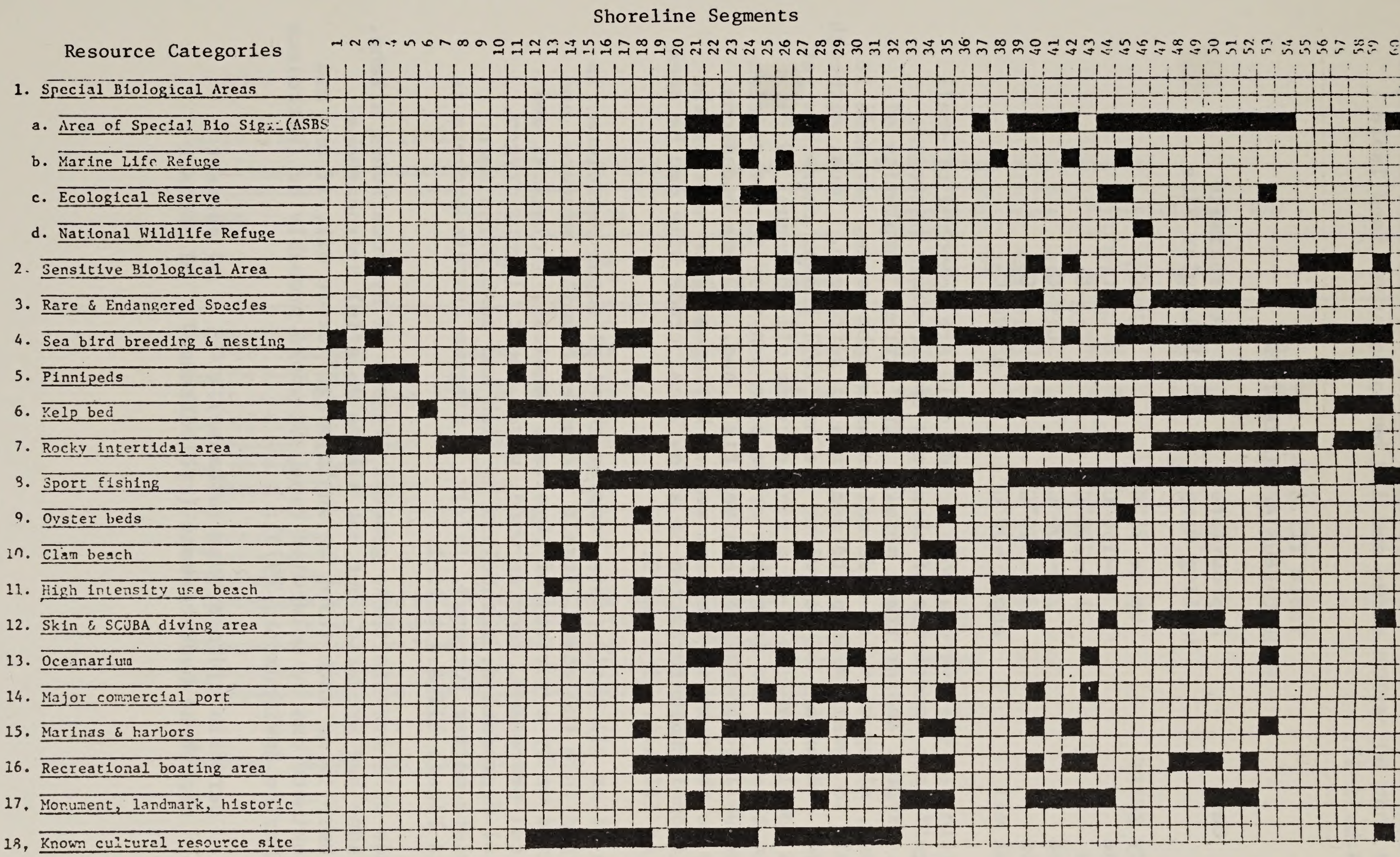


Figure III.A.4.b.i-27 Land segment numbers.

Table III.A.4.b-1

OIL SPILL IMPACTS



of one carbon atom and four hydrogen atoms, to hydrocarbons composed of more than 60 carbon atoms and 120 hydrogen atoms (see Table III.A.4.b.ii-1).

Table III.A.4.b.ii-1
HYDROCARBON APPROXIMATION

Cut	Approximate Boiling Range	Approximate Molecular Size
Refinery gases	up to 25°C	C_3-C_4
Gasoline	40-150°C	C_4-C_{10}
Naphtha	150-200°C	C_{10}-C_{12}
Kerosene	200-300°C	C_{12}-C_{16}
Gas oils	300-400°C	C_{16}-C_{25}
Residual oil	above 400°C	above C_{25}

In addition to the hydrocarbons, crude oils are composed of small but significant quantities of chemicals that contain nitrogen, sulfur, oxygen, and/or trace metals. The extreme complexity of petroleum, along with its wide molecular weight range, has made it difficult to obtain a complete analysis of petroleum. Thus, although the major components of petroleum are now well known, there has yet to be a complete analysis of a single crude oil (Oceanus, 1977). Added to this, is the fact that crude oils can vary in composition from one well to another in a given field and, on some occasions, one day to the next in the same well. Differences in some of the compositional characteristics of a few local crude oils can be seen in Tables III.A.4.b.i-2 and 3.

In case of an oil spill, this complex chemical soup, petroleum, is discharged into the ocean, itself a complex chemical mixture, and then acted on by a variety of physical, chemical, biological and geological processes, such as wind, waves, heat, light, oxygen, microbial degradation, metabolism by fish and adsorption onto particulate matter (Oceanus, 1977). A diagram of this process is shown in Figure III.A.4.b.ii-1.

All crude oils contain three general classes of hydrocarbons: alkane, cycloalkane and aromatic, but not alkene (olefin) hydrocarbons. While there is no such thing as an "average" crude oil, if one had to approximate one by molecular type, it would probably be (Petroleum in the Marine Environment, 1975):

paraffin hydrocarbons (alkanes)	30 percent
naphthene hydrocarbons (cycloalkanes)	50 percent

Table III.A.4.b.ii-2

Gross compositional characteristics of Coal Oil Point and Carpinteria seeps, Santa Barbara area, California

Sample	Percent of total oil				Percent of hexane fraction		Percent of total oil		S/N
	C_6 fraction [1]	ϕ fraction [2]	MeOH fraction [3]	non-eluted	n-alk. [4]	B/C [5]	S	N	
Carpinteria seep (Pico Formation)	28.71	50.78	13.40	7.11	2.63	97.37	3.02	0.78	3.9
Coal Oil Point seep [6] (Monterey Formation)	20.01	56.13	11.62	12.24	2.05	97.95	4.54	0.50	9.1
Coal Oil Point seep [7] (Monterey Formation)	27.10	43.83	9.83	19.24	3.87	96.13	4.97	0.42	11.8
Coal Oil Point seep [8] (Monterey Formation)	28.28	45.98	8.45	17.29	2.13	97.87	4.92	0.51	9.7

1 Hexane elutae.
2 Benzene eluate.
3 Methanol eluate.
4 Components occluded by 5-Å molecular sieve reflux (n-alkanes).
5 Components not occluded by 5-Å molecular sieve reflux (branched + cyclic alkanes).
6 Sample collected from "Coal Oil Point seepage area" (Wilkinson, 1972).
7 Sample collected in 18 m of water from "La Goleta seepage area" (Wilkinson, 1972).
8 Sample collected from "Isla Vista seepage area" (Wilkinson, 1972).

Source: Reed and Kaplan, 1976

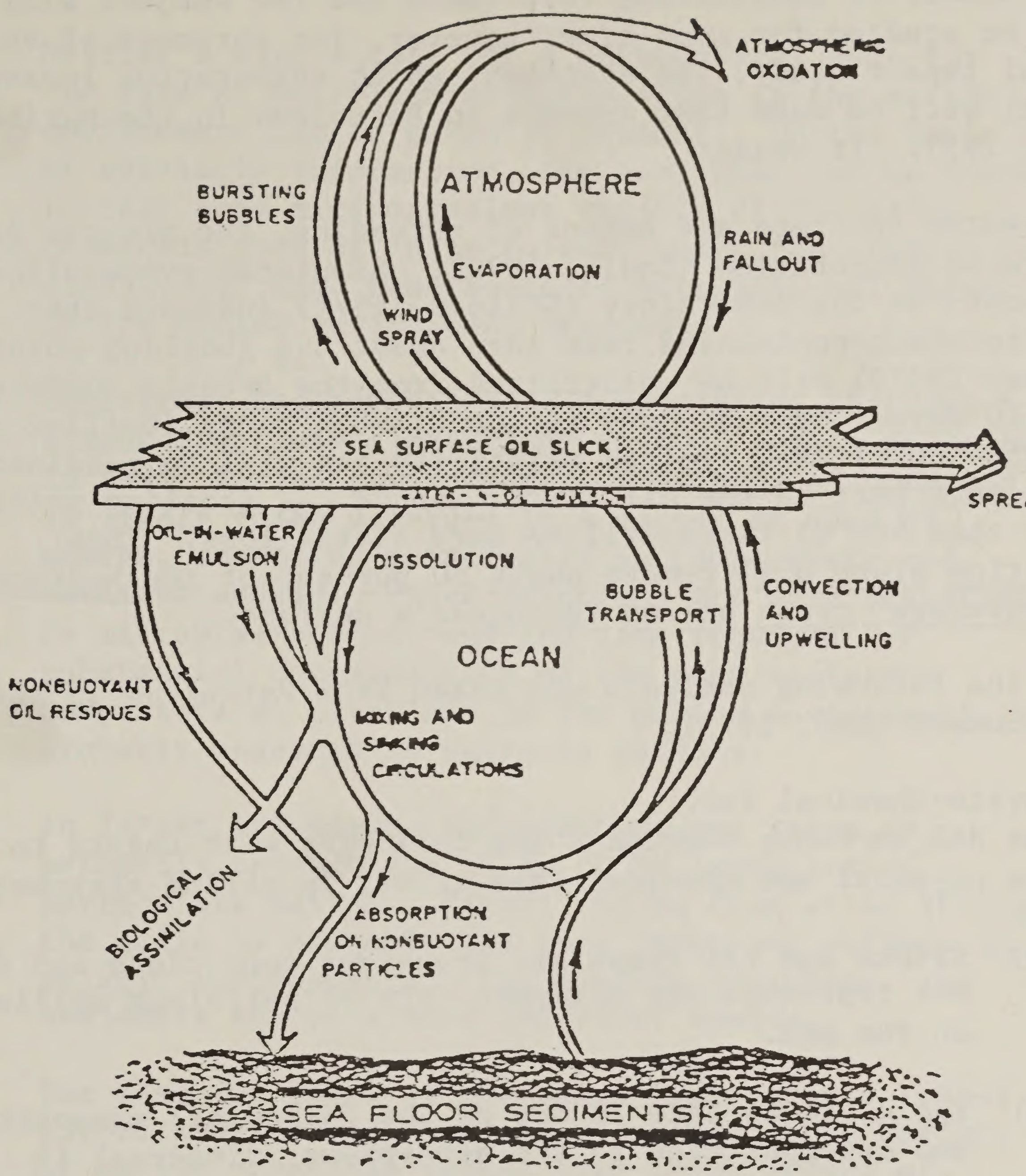
Table III.A.4.b.ii-3

Gross compositional characteristics of production oils, Southern California Borderland

Samples	Percent of total oil				Percent of hexane fraction		Percent of total oil		S/N
	C_6 fraction [1]	ϕ fraction [2]	MeOH fraction [3]	non-eluted	*n*-alk. [4]	B/C [5]	S	N	
Vaqueros Formation (Lower Miocene)									
Summerland field									
Flowline samples (all prod. wells)	36.08	24.02	6.62	33.28	13.62	86.38	0.18	0.19	0.95
Deveraux field (Well 308 No. 4)	51.37	16.47	16.47	15.69	16.16	83.84	0.10	0.08	1.25
Elwood field (Well 208 No. 14)	32.61	12.93	6.86	47.60	13.97	86.03	0.14	0.22	0.64
Repetto Formation (Lower Pliocene)									
Dos Cuadras field									
Flowline samples (all prod. wells)	27.78	27.80	4.89	39.53	4.35	95.65	0.85	0.33	2.58
Dos Cuadras field (Well A-20)	36.69	23.89	5.05	34.37	10.25	89.75	0.86	0.41	2.10
Pico Formation (Upper Pliocene)									
Carpinteria field									
flowline samples (all prod. wells)	38.27	35.93	5.91	19.89	11.64	88.36	1.81	0.30	6.03

1 Hexane eluate.
2 Benzene eluate.
3 Methanol eluate.
4 Components occluded by 5-Å molecular sieve reflux (*n*-alkanes).
5 Components not occluded by 5-Å molecular sieve reflux (branched + cyclic alkanes).

Source: Reed and Kaplan, 1976



Source: Adapted from Garrett, 1972

Figure III.A.4.b.ii-1 Natural Forces Which Disperse and Modify Petroleum Slicks on Water.

aromatic hydrocarbons	15 percent
nitrogen, sulfur & oxygen-containing compounds (NSO's)	5 percent

There are a number of conflicting references and the subject will continue to be studied for some time; however, for purposes of this environmental impact study, the statement about evaporation losses for crude oil will be used that appears in Petroleum in the Marine Environment, 1975. It reads:

> "The greater the rate and extent of spreading, the greater is the rate of evaporation (Hoult, 1972). Simulated evaporation experiments in the laboratory (Kreider, 1971) indicate that all hydrocarbon containing less than about C_{15} (boiling point less than 250°C) will be volatilized from the ocean's surface within 10 days. Hydrocarbons in the C_{15}-C_{25} range (boiling point 250-400°C) show limited volatility and will be retained for the most part in the oil slick. Above C_{25} (boiling point greater than 400°C) there will be very little loss. <u>Thus evaporation alone will remove about 50 percent of the hydrocarbons in an "average" crude oil on the ocean's surface</u>.

The bulk of the following analysis was taken from Petroleum in the Marine Environment (NAS, 1975).

(1) Physio-Chemical Fate
The NAS workshop concluded the following with regard to the physical and chemical fate of oil in marine systems:

(a) Slicks and tar lumps are transient conditions and do not represent the ultimate fate of petroleum spilled on the sea.

(b) The ultimate fate is one of the following: evaporation and decomposition to the atmosphere, dispersal in the water column, incorporation into sediments, oxidation by chemical or geological means to CO_2.

(c) The standing crop of petroleum-like material in the form of slicks and floating lumps is of the order of a year's input. Tar stranded on rocky shores may have a much larger lifetime.

(d) Crude oil and some petroleum products transported by sea can easily form tar. Occurrence of pelagic tar correlates with intensity of tanker traffic in different regions of the ocean.

(2) Biological Fate

The NAS workshop concluded the following with regard to the biological fate of oil in marine systems:

(a) Neither a single rate nor a mathematical mode for the rate of petroleum biodegradation in the marine environment can be given at present. On the basis of available information, the most that can be stated is that some microorganisms capable of oxidizing chemicals present in petroleum (under the right conditions) have been found in virtually all parts of the marine environment examined.

(b) Laboratory experiments have demonstrated that the n-alkane fraction of petroleum is most easily degraded. In toxic marine environments, this type of compound is likely to be degraded in a matter of days or months, depending principally on temperature and nutrient supply. Other fractions are more resistant to microbial action, and the time required for substantial decomposition of the most resistant components of petroleum in the marine environment is probably measured in years to decades.

(c) In larger organisms, hydrocarbons are taken up primarily through the gills or by ingestion of particulate matter. Direct intake from water through the gills is probably the most important pathway in pelagic environments. For benthic organisms, the sediments may be a more important source.

(d) The measured level of petroleum hydrocarbons (after correction for biogenic contributions) in a variety of marine organisms ranges over three orders of magnitude (1 µg/g to 400 µg/g wet weight).

(e) Some organisms (e.g., copepods) can ingest large quantities of petroleum and eliminate it directly as fecal matter without substantial degradation.

(f) Some fish and crustaceans metabolize petroleum hydrocarbons within two weeks; in plankton and benthic invertebrates, however, metabolism is slow and the pathways are poorly understood.

(g) Storage of hydrocarbons, including those from petroleum, occurs in the lipids of many organisms. Biogenic

hydrocarbons, particularly di- and triolefins, are often clearly distinguishable from petroleum.

(h) Some organisms (e.g., mussles and oysters) can eliminate most petroleum hydrocarbons (but not all) after absorption if placed in unpolluted water.

(i) Discharge by vertebrates occurs primarily through the gall bladder and kidney. Paths of discharge for invertebrates are not well established.

(j) There is no evidence for food web magnification in the case of petroleum hydrocarbons in the marine environment. On the contrary, evidence is strongest that direct uptake from the water or sediments is more important than from the food chain.

Effects. Table III.A.4.b.ii-4 shows that a limited number of documented studies exist that consider the biological, chemical and physical acute and long-term effects of oil in the marine environment. Because most studies have been made in estuaries, little data are available concerning effects on the open ocean. However, certain generalizations about various aspects of oil in the marine environment can be made.

Whereas the concentration of petroleum hydrocarbons dissolved in water is generally low (<10 ppb) it was found to be much higher in sediments, ranging from 1,500 to 5,700 ppm in polluted coastal sediments (natural indigenous hydrocarbons in sediments in nearby unpolluted areas ranged from 26 to 130 ppm). On the outer coastal shelf, concentration in sediments might be as high as 20 ppm, whereas in the deep ocean 1-4 ppm was the usual concentration.

In general, where damage was severe, the oil spill was massive relative to the size of the affected area, and the spill was confined naturally or artificially to a limited area of relatively shallow water (less than 6 m) for a period of several days. Deleterious effects may have been increased by storms or heavy surf water mixed with oil and sediments in the affected area. These effects were also generally localized, ranging from a few miles to tens of miles, depending on ecological and environmental circumstances; however, for a given quantity of oil, the more localized the distribution of the spill, the greater is the mortality.

Different oils were found to have different effects, with toxicity being most pronounced for refined distillates and

Table III.A.4.b.ii-4 A Summary of Several Major Oil Spills Followed by Studies Of Their Biological Impact.

Date of Spill	Source and Location	Type and Amount of Oil (barrels)	Shoreline Affected (mi)	Localities Studied	Species Identified	Sampling Method	Biological Damage	Reference
March 1957	Tampico Maru, Baja California, Mexico	Diesel oil 60,000	2	Intertidal & subtidal	Larger visible plants and animals	Qualitative, quantitative macrocystis counts	Nearly total devastation immediately, luxuriant growth of seaweed developed within months; biota 90% restored after 3 or 4 years, although relative abundance of certain species still somewhat changed after 12 years	North et al., 1964; Mitchell et al., 1970
July 1962	Argea Prima, Guayanilla Harbor, Puerto Rico	Crude oil 70,000		Mangrove shores; intertidal and subtidal	Blue-green algae	Qualitative	Extensive damage: high mortalities among many shallow water and shore-dwelling organisms, including a wide variety of vertebrates; also extensive damage to intertidal and sublittoral algae and mangrove habitat	Diaz-Piferrer, 1962
Jan. 1967	Chrysasi P. Goulandris, Milford Haven England	Crude oil 1,800		Intertidal salt marsh; intertidal rocky shore	Grasses	Semiquantitative rocky shore transect; quantitative studies of grasses	Most damage to intertidal organisms; gastropod molluses badly affected, also barnacles and sea anemones on a number of shores; no apparent damage to algae	Cowell, 1969; Nelson-Smith, 1968
March 1967	Torrey Canyon, S.W. England	860,000		Intertidal rocky shores and sand beach	Larger visible animals only	Semiquantitative rocky shore transects; qualitative beach and subtidal surveys; quantitative algal counts	Very high mortalities of intertidal shore life, mostly due to use of toxic emulsifiers; many invertebrates and algae killed on shores; fisheries and plankton apparently unaffected; estimated 10,000 birds killed	Bellamy et al., 1967; Smith, 1968
Sept. 1967	R.C. Stoner, Wake Island	Aviation gas, J-P4 jet fuel, A-1 turbine oil, and Bunker C oil 126,000		Intertidal & subtidal	Large visible invertebrates	Qualitative	Many dead fish stranded on shores; also abundant dead molluscs, sea-urchins, and crabs	Gooding, 1968
March 1968	Ocean Eagle, San Juan Harbor, Puerto Rico	Crude oil 83,000		Intertidal rocky shore	15 large sp.	Qualitative	Many subtidal and intertidal organisms killed or damaged by oil or oil and emulsified, including molluscs, crustaceans, and algae, although subsequent recovery good; 10 species of fish found dead or in state of stress	Cerame-Vivas, 1968
April 1968	Esso Essen, S. Africa	Crude oil 20,000-28,000		Intertidal & subtidal	No species identifications, observations on larger organisms	Qualitative	High mortalities of sandhoppers (amphipods) but otherwise little damage on shores; high bird mortalities	Stander and Ventner, 1968
Dec. 1968	Witwater, Galeta Island, Canal Zone	Diesel and Bunker C oil 20,000		Rocky intertidal coral reef, sandy intertidal mangroves	Uca, mangrove species, four coral species	One quantitative sand sample for meiofauna; otherwise qualitative	On rocky shores, extensive mortality of supralittoral vegetation and tide pool life; on sandy beaches, great population decreases among meiofauna, especially crustaceans; many young mangroves killed in swamp areas, also algae and many invertebrates; coral reefs apparently unharmed	Rutzler and Sterrer, 1970

Table III.A.4.b.ii-4 (Continued)

Jan. 1969	Well A-21, Santa Barbara Channel	Crude oil 33,000	40	Intertidal & subtidal	Subtidally: selected polychaete families, ophiuroids, and molluscs not including smaller polychaetes and amphipods; intertidally: visible rocky shore species and 195 sp. retained by 1.5mm screens in sandy areas	Grab sample, qualitative at species level; quantitative for biomass line transects on rocky shores; 1/100 m^3 samples on beaches	High mortalities of intertidal organisms covered with oil; about 3,600 birds killed; no apparent effects on fish and plankton; no directly attributable damaging effects of oil on large marine mammals or on benthic fauna; area recovering will within a year	Cimberg et al 1973; Fauchald, 1971; Foster et al. 1971a,b; Nicholson and Cimberg, 1971; Straughan, 1972
Sept. 1969	Florida, West Falmouth, Mass.	No. 2 fuel oil 4,500	3	Intertidal mud and sand flats; subtidal to 10 mm	All animals 0.247mm, excluding nematodes, copepods; ostracods and unicellular organisms, including smaller polychaetes and amphipods	Quantitative transects	Severe pollution of sublittoral zone, with 95% kill of all fauna, including many fish, worms, molluscs, crabs, lobsters, and other crustaceans and invertebrates; local shellfish industry severely affected; Wild Harbor still closed to shellfish fishing in May 1974	Blumer and Sass, 1972; Blumer et al., 1970a,b
Feb. 1970	Arrow, Chedabucto Bay	Bunker C 108,000	12	Intertidal rocky shore; intertidal lagoon	Common visible species on rocky shore and species 74 mm in lagoon samples	Semiquantitative transects; 2 samples in lagoon	Localized damage to intertidal life, where most mortalities were crabs, limpets, and algae, probably killed by smothering; local fish catches normal; about 2,300 birds killed; 5 months after spill, subtidal flora and fauna healthy; fishing and lobstering normal	Thomas, 1973; Navships, 1970
Jan. 1971	Arizona Standard and Oregan Standard, San Francisco Bay	Bunker C 20,000	60	Intertidal & subtidal rocky shore; intertidal sand beach	31 larger sp.	Quantitative transect counts	Some damage to shore life, mainly to acron barnacles, limpets, mussels, and striped shore crabs; 3,600 birds killed; area nearly normal within 1 year	Chan, 1973
Feb. 1971	Wafra, Cape Aulhas, S.Africa	Crude oil 445,000	10	Intertidal rocky shores	Larger intertidal rocky shore species	Qualitative	Little damage to intertidal life; 1,135 black footed penguins found oiled	Day et.al., 1971
April 1971	March Point Dock Facility, Anacortes, Washington	No. 2 fuel oil 5,000	20	Intertidal beaches, rocky shores, subtidal	Animals 4mm in subtidal samples, visible fauna identified to major taxa only	Quantitative grabs; quantitative intertidal transects	Some oil on shores, damaging shellfish, limpets, crabs, clams and oysters; about 1,000 birds involved	Watson et al., 1971; Woodin et al., 1973
Jan. 1972	General M.C. Meigs, Wreck Cove, Washington Coast	Navy special oil 3,000	300-500 yd	Intertidal rocky shores	37 sp. algae, sp. animals not including smaller polychaetes and amphipods	Quantitative transects	Urchins affected; plant community showed less of fronds and bleached thalli	Clark et al., 1973

Source: NAS, 1975.

physical smothering most severe with viscous crude oils or Bunker C crude oil. Refined No. 2 fuel oil was among the oils having the most toxic effect. Variations in physical environment in coastal areas were also considered in determining effects, i.e., a polluted area might experience sudden and unpredictable stresses from synergistic interactions between variable environmental factors and the oil.

The amount of oil and the type of organisms affected was also found to be important. For example, a single coating of fresh or weathered crude oil or its derivatives on certain bird species or on seeds of plants caused death, whereas marsh plants were killed only after several coatings. In general, emergent plant life was less likely to be affected than marine biota, unless the spill occurred in tropical waters where mangroves were present. Very low concentrations of the soluble fractions of kerosene interfered with searching behavior of a marine snail. Crude oil on the shells of oysters had no effects. The photosynthesis of marine phytoplankton was reported to be reduced by 100 ppb of No. 2 fuel oil. Mortality of some organisms has been found in all major spills for which studies have been published, with the pelagic diving birds being the most obvious casualties. The extent of the mortality depended on local conditions and was greatest when the releases of oil were confined to inshore areas where natural marine resources were abundant. Intertidal organisms tended to be more resistant to stress than subtidal species. In one instance, where the herbivores were reduced, the intertidal plants on which they fed increased markedly. In laboratory studies where organisms were near their limits of tolerance to temperature or salinity, pollution products caused a much greater change in metabolic rates than when the physical conditions were nearer optimum.

The recovery of polluted areas varies greatly, depending on the flushing of the polluted areas, the type of the sediments in the substrata, and the degree of isolation of its ecosystems and the kinds of organisms that form them. The time period for recovery may vary from a few months to several years. In general, the initial stages of recovery are characterized by opportunistic species that are often very productive, with a much longer time required to restore the community to one that supports more long-lived species.

One characteristic of organisms composing an ecological community that may affect its stability and rate of recovery is, for example, a slow rate of reproduction or growth. Such a characteristic increases the vulne. bility of a species or ecological community to damage from oil or any other pollution. Marine birds in the planning area may have similar responses.

Some aquatic species that live only in brackish regions of estuaries have planktonic larvae. If these drifted passively in the current, they would be washed out into the open sea and lost; instead, they dive deeper after drifting toward the mouth of the estuary and are carried by the deeper currents back to where they were spawned in the brackish regions. Thus, if the estuary is an isolated one, almost all the recruitment of these organisms is from the offspring of the resident population. If this population were completely destroyed by pollution, recolonization by chance immigration from a distant estuary would probably take a very long time. The resident population of estuaries provides shelter and food for the young stages of many commercially important marine organisms (shrimp, fish, etc.).

There is very little data on the effect of oil on pelagic species. Without more research, it is clearly premature to conclude anything about the effects of oil on the open ocean.

The information base with regard to the effects of oil in the marine environment on human health is extremely limited. However, certain observations have been made:

(1) Compounds with carcinogenic properties are among the hydrocarbon compounds released into the environment.

(2) Direct uptake by marine organisms of these compounds can occur.

(3) Hydrocarbons are stored in the lipids of marine organisms.

(4) Organisms capable of storing hydrocarbon are common human dietary items.

(5) Hydrocarbon uptake from marine organisms by man is possible.

(6) The quantities accumulated from this source are probably low.

(7) The significance of this uptake as related to carcinogenesis is unknown.

Based on this limited information, the National Academy of Sciences (1975) tentatively concluded that modest concern rather than alarm appears to be justified. Although it is known that petroleum contains small amounts of carcinogens and possibly small amounts of other harmful materials, the amounts of carcinogens known to be in petroleum that could be ingested by

eating marine organisms is estimated (NAS, 1975) to be no greater than that acquired from eating any other foods.

When petroleum or petroleum products are released on the ocean's surface, weathering processes immediately begin to alter the material that spreads out over the surface of the ocean. The extent of spreading is affected by wind, waves and currents, but probably more by the physical and chemical nature of oil.

To properly assess the behavior of petroleum spills at the air-sea interface, its area of coverage, thickness, and physical condition must be determined as a function of time. Fay (1969), considering the spread of oil on a calm sea, concluded that gravitational effects controlled spreading in the initial stages of a spill. Other factors dictate spreading characteristics as the oil layer thins. For example, consider a crude oil with an interfacial tension of 30 dyn/cm and a density of 0.05 g/cm^3. If such an oil is spread on water, surface forces become influential once the oil has thinned to 0.8 cm.

In field experiments, on the other hand, the area occupied by an oil slick is observed to increase rapidly under the influence of both hydrostatic and surface forces. This area, which depends empirically on the volume spilled, eventually becomes constant as further enlargement is limited and offset by natural dispersive forces and other mechanisms. From available spill data, it is apparent that even the viscous crudes spread rapidly into thin layers that are then influenced by surface effects. For example, Berridge, et al., (1968a,b) using an equation derived by Blokker (1964) (Table III.A.4.b.ii-5), calculated that 100 m^3 of various crudes will thin to an average value of 0.055 cm after only 17 min, 0.012 cm after 3 hours, and 0.003 after 28 hours. Allen (1969) estimates a minimum average thickness of 0.0025 cm for the Santa Barbara incident, assuming that spreading had occurred for 24 hours. Similarly, Smith (1968) estimated that the massive 10 x 40 mi oil slick observed 6 days after the Torrey Canyon spill would have had an average thickness of 0.003 cm, a value strikingly similar to other above-cited estimates. Thus, even the large spills eventually spread into thin layers. It should be noted, however, that these thickness estimates are averages. Once a spill has thinned to the point that surfaces forces begin to play an important role, the oil layer is no longer continuous and uniform, but becomes fragmented by wind and waves into islands and windrows where thicker layers of oil are in equilibrium with thinner films rich in surface active compounds. Observations (Figure III.A.4.b.ii-2) of experiemental spills (P.G. Jeffrey, 1973; Hollinger and Mennella, 1973) have shown that with time one or more patches of thick oil (several millimeters thick)

Table III.A.4.b.ii-5 Blokker Constants Calculated from Observed Maximum Slick Dimension, 120-Ton Spill[a].

Time from $t = 0$ (min)	Maximum Slick Dimension (km)	Blokker Constant $(K_r)^b$
0	0.225	
4	0.279	319
17	0.344	199
22	0.366	195
27	0.356	144
33	0.417	194
42	0.505	313
48	0.521	301
98	0.582	189
119	0.654	251
124	0.689	285
422	0.751	109
427	0.876	170
514	0.876	142
517	0.835	125
2820	1.44	117
3088	2.16	360
5760	2.40	265

[a] From P. G. Jeffrey, 1973.

[b] $K_r t = \pi(r^3{}_t - r^3{}_0)\, d_w / 3V(d_w - d_o) d_o$, where K_r is a constant referred to as the Blokker constant, r_t and r_0 are the radii of the slick, assumed to be circular in shape, t is the spreading time in seconds, V is the volume of oil in the slick in cm^3, and d_w and d_o are the density of seawater and the oil.

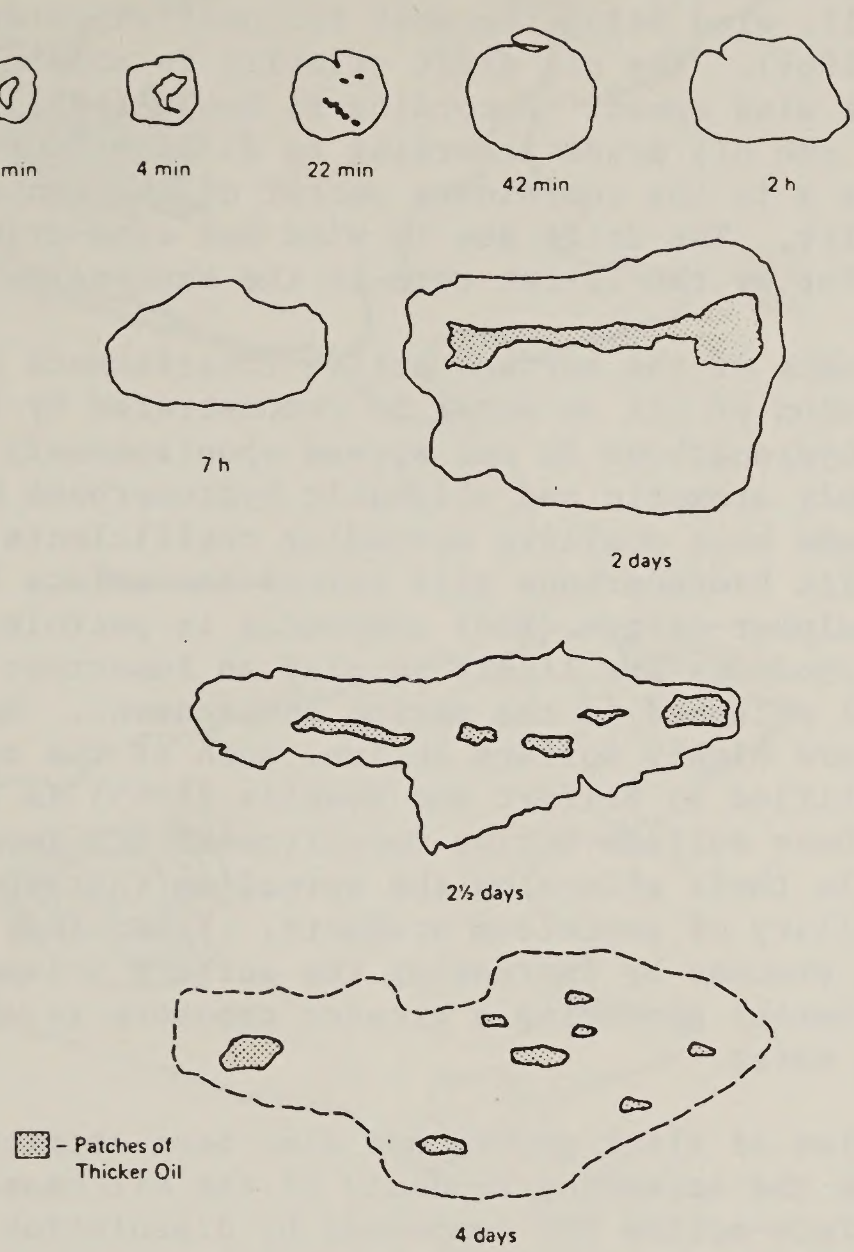


Figure III.A.4.b.ii-2 A series of diagrams showing the outline development and subsequent breakup of the oil slick (P.G. Jeffrey, 1973).

were surrounded by a much larger area of thin film (less than 4 mm). Approximately 90 percent of the oil volume was located in these thicker layers that occupied only 10 percent of the visible slicked area of the sea (Figure III.A.4.b.ii-3).

In addition, surface currents driven by wind, waves, and convectional cells determine the shape and direction of movement of the spill, wind being the most influential external factor (Blokker, 1964). The oil drift velocity is about 3 percent that of the wind speed. According to Hoult (1972) the center of mass of the oil moves according to $dx/dt = U_{current} + 0.035\ U_{wind}$ where x is the coordinate vector of the center of mass and $U_{velocity}$. The drift due to wind and wind-driven waves is accounted for by the latter term in the expression.

The importance of the surface active constituents in spreading and dispersion of oil on water is demonstrated by the fact that most pure hydrocarbons do not spread spontaneously by surface forces. Only aromatic and aliphatic hydrocarbons more volatile than n-nonane have positive spreading coefficients, while none of the cyclic hydrocarbons will spread by surface forces. The nitrogen-sulphur-oxygen (NSO) compounds in petroleum and petroleum products are likely to play an important role in the fate of oil released in the marine environment. Many of these compounds are highly surface active, such as the cyclic carboxylic acids identified by Seifert and Howells (1969) in California crudes. These surface active constituents are immediately important in their effect on the spreading characteristics and emulsifiability of petroleum products. Thus, they enhance the weathering process by increasing the surface volume ratio of the oil, thereby producing a greater exposure to air and underlying water.

The cessation of slick growth has also been attributed to a decrease in the spreading tendency of the oil caused by loss of the surface-active NSO compounds by dissolution (Fay, 1971). However, most of these compounds are not much more soluble than hydrocarbons (see below), and it is more likely that weathering of petroleum products containing heavy end results in an eventual semisolid mass (the precursor to a tar ball) that is no longer fluid and does not spread. This could also be a water-in-oil emulsion (see below). Because the NSO constituents are encased within the semisolid matrix, their loss would be extremely slow. This contention is supported by surface film pressure data (W. D. Garrett, personal communication), that indicates that the concentrations of polar surface active compounds are higher in tar balls than in the parent oils from which they were formed.

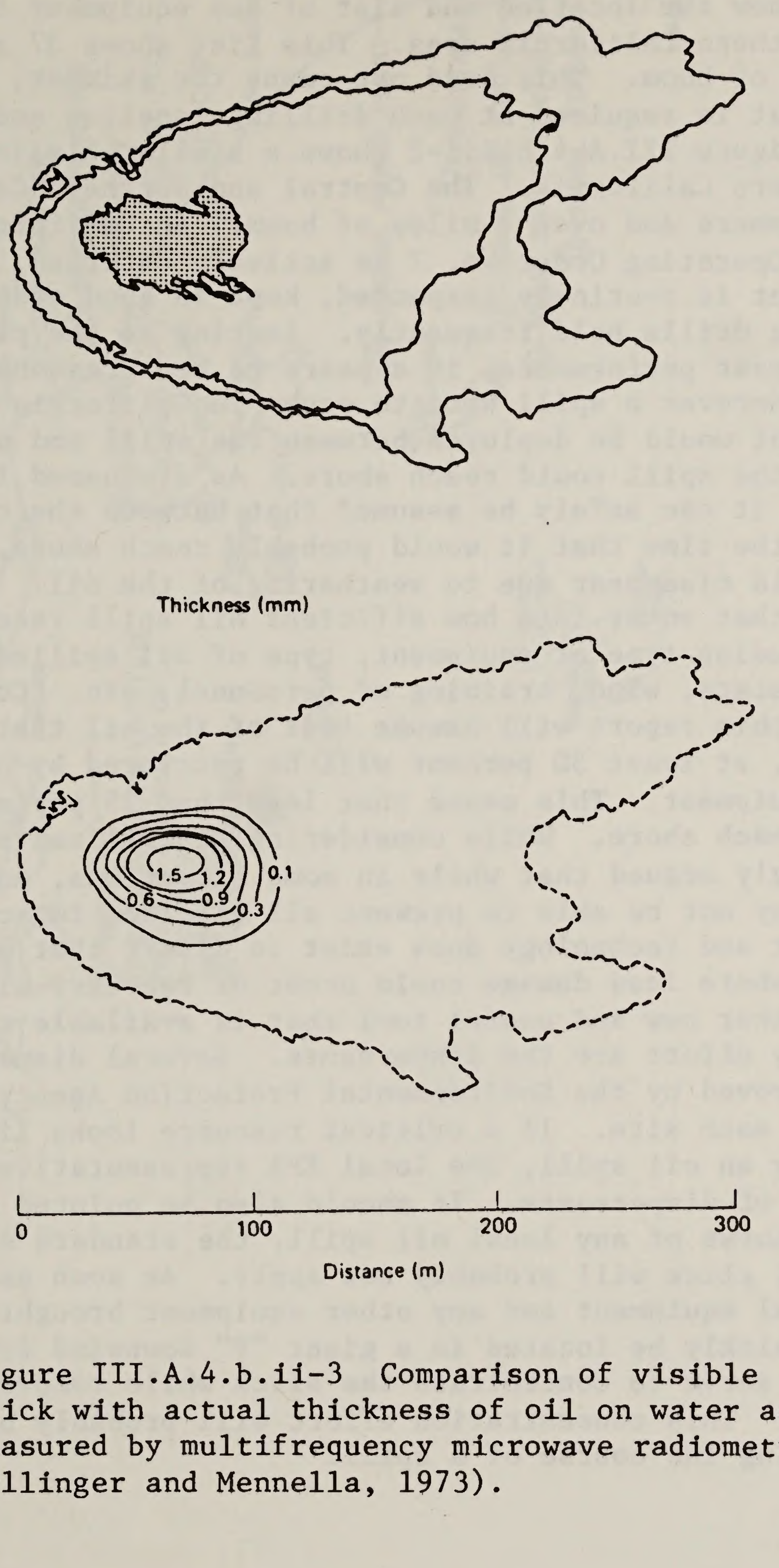


Figure III.A.4.b.ii-3 Comparison of visible slick with actual thickness of oil on water as measured by multifrequency microwave radiometry Hollinger and Mennella, 1973).

iii. Oil Spill Cleanup Capability: As discussed in Section II.H.5, California probably has more and better equipped oil spill cleanup cooperatives, oil companies, and cleanup contractors than any other place in the world. Figure III.A.4.b.iii-1 and Table III.A.4.b.iii-1 show the location and list of key equipment of key groups in the Southern California area. This list shows 37 skimmers and over 25 miles of boom. This does not count the skimmer, boom, and dispersent that is required at each drilling location and on each platform. Figure III.A.4.b.iii-2 shows a similar listing for Central and Northern California. The Central and Northern California list shows 15 skimmers and over 3 miles of boom. In California waters, the USGS Operating Order No. 7 is actively enforced. All oil spill equipment is routinely inspected, kept in good order, and personnel training drills held frequently. Looking at the placement of equipment and past performance, it appears to be a reasonable assumption that wherever a spill were to occur in California waters, oil spill equipment would be deployed between the spill and any shoreline before the spill could reach shore. As discussed in the previous section, it can safely be assumed that between the time of an OCS spill and the time that it would probably reach shore, 50 percent of it would disappear due to weathering of the oil. There are many factors that enter into how efficient oil spill recovery can operate, including type of equipment, type of oil spilled, temperature, sea state, wind, training of personnel, etc. Considering all the factors, this report will assume that of the oil that could reach a shoreline, at least 50 percent will be recovered by oil spill recovery equipment. This means that less than 25 percent of any spill could reach shore. While considering generalized situations, it could be strongly argued that while in some situations, an oil recovery effort may not be able to prevent all oil from impacting a beach; equipment and technology does exist to divert that oil to another location where less damage could occur or recovery might be made easier. Another new and useful tool that is available to the oil spill recovery effort are the dispersants. Several dispersants have now been approved by the Environmental Protection Agency (EPA) and are stored at each site. If a critical resource looks like it may be impacted by an oil spill, the local EPA representative can authorize the use of dispersants. It should also be pointed out that during the course of any local oil spill, the standard spreading factors for an oil slick will probably not apply. As soon as a spill occurs, local equipment and any other equipment brought out from shore will quickly be located in a giant "V" downwind from the spill. This will serve to concentrate the slick while recovery attempts are made. This concentration effort will probably be made several times during the course of a spill.

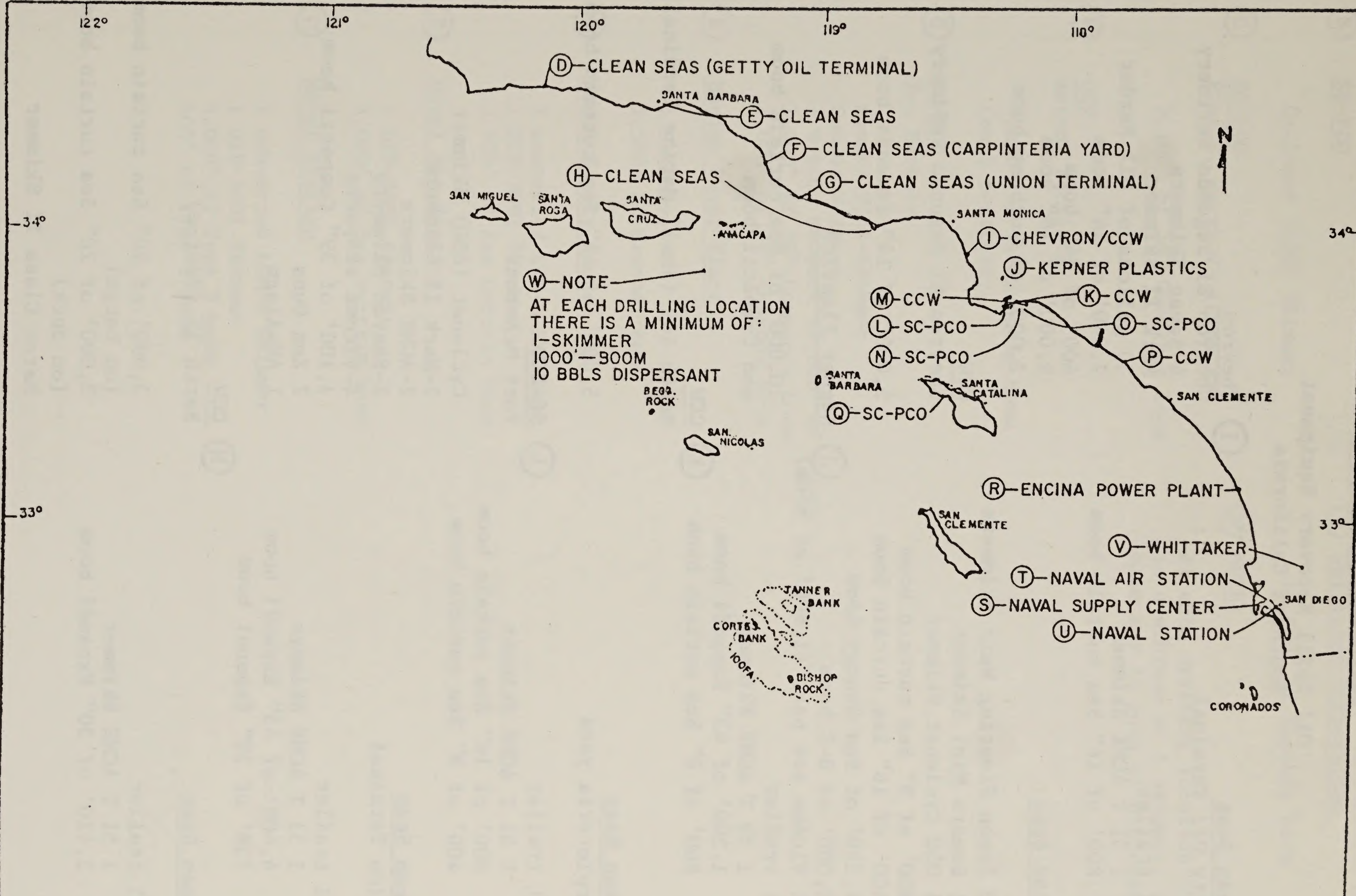


Figure III.A.4.b.iii-1 Oil Spill Recovery Equipment - Southern California.

Table III.A.4.b.iii-1

Oil Spill Recovery Equipment
Southern California

(D) Clean Seas
Getty Oil Terminal

1 trailer
1 51 T ACME Skimmer
800' of 16" Sea curtain boom

(E) Clean Seas

3 Exxon Floating Weir skimmers
1 Komara Mini Skimmer
1 050 Cyclonet Skimmer
800' of 8" Sea curtain boom
400' of 16" Sea curtain boom
1,210' of Sea Sentry boom
2,000' of B-T boom
1 Vicoma sea pack (1,600' of boom)
1 trailer
1 39 T ACME Skimmer
1,500' of 43" Expandi boom
800' of 8" Sea curtain boom

(F) Clean Seas
Carpinteria yard

1 trailer
1 51 T ACME Skimmer
800' of 16" Sea curtain boom
400' of 8" Sea curtain boom

(G) Clean Seas
Union Terminal

1 trailer
1 51 T ACME Skimmer
4,400' of 43" Expandi boom
738' of 30" Expandi boom

(H) Clean Seas

1 trailer
1 51 T ACME Skimmer
2,410' of 30" Expandi boom

(I) Chevron
Chevron El Segundo Refinery
4 Sevac Skimmers
Mark II Skimmer
30 gallons of Oil Herder
2,240' of 24" boom
600' of 34" boom
9,000' of 18" boom
2,000' of Sorbent boom

CCW
Chevron El Segundo Refinery

5,000' of 14" Expandi boom

(J) Kepner Plastics

10,000' of Sea curtain boom
and Compacti boom

(K) CCW
Berth 169 (Shell Marine Terminal)

5,000' of 14" Sea curtain boom

(L) SC-PCO
Fort McArthur

Cyclonet (050) Skimmer
2-Mark II Skimmers
2-ACME Skimmers
2-Seavac Skimmers
4-Vicoma seapacks
3,100' of 39" Compacti boom
2 Zon Guns
1 AV-Alarm

(M) CCW
Berth 35 (Pactow)

3,000' of 20" Sea curtain boom
(on barge)
2,000' of 20" Sea curtain boom
(on dock)
Marco Class II Skimmer

SC-PCO
Cyclonet (100) Skimmer

(N) SC-PCO

Cyclonet (150) Skimmer

(O) SC-PCO
Pier C, Berth 21 (Crowley)

3,100' of 36" Goodyear boom

(P) CCW
Aminol Facility

9,000' of 14" Expandi boom
(on 3 trailers)

(Q) SC-PCO
Two Harbors

Komara Mini-Skimmer
Seavac Skimmer
1 Vikoma Seapack (1,600' of boom)
1,000' of 39" Compacti boom
1,000' of 29" expandi boom

(R) Encina Power Plant

1 Skimmer
1,500' of Expandi boom

(S) Naval Supply Center

1 converted LCM-6 Skimmer
1 DIP-3001 Skimmer
3,000' of Sea Curtain boom

(T) Naval Air Station

1 DIP-3001 Skimmer
3,000' of Sea curtain boom

(U) Naval Station

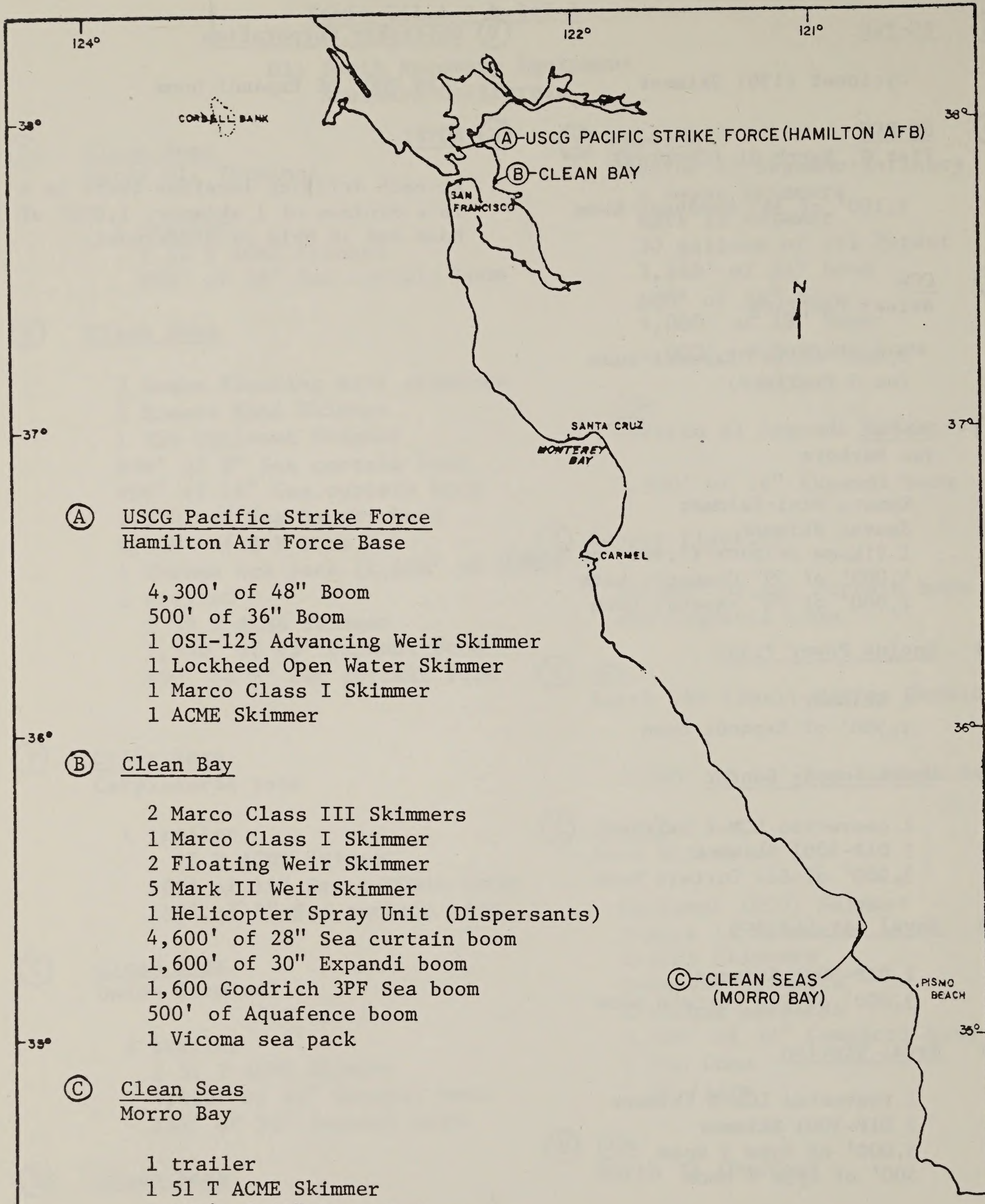
1 converted LCM-6 Skimmer
1 DIP-3001 Skimmer
5,000' of Type 3 boom
500' of Type 1 boom

(V) Whittaker Corporation

10,000' of Expandi boom

(W) NOTE:

At each drilling location there is a is a minimum of 1 skimmer, 1,000' of boom and 10 bbls of dispersant.



(A) USCG Pacific Strike Force
Hamilton Air Force Base

4,300' of 48" Boom
500' of 36" Boom
1 OSI-125 Advancing Weir Skimmer
1 Lockheed Open Water Skimmer
1 Marco Class I Skimmer
1 ACME Skimmer

(B) Clean Bay

2 Marco Class III Skimmers
1 Marco Class I Skimmer
2 Floating Weir Skimmer
5 Mark II Weir Skimmer
1 Helicopter Spray Unit (Dispersants)
4,600' of 28" Sea curtain boom
1,600' of 30" Expandi boom
1,600 Goodrich 3PF Sea boom
500' of Aquafence boom
1 Vicoma sea pack

(C) Clean Seas
Morro Bay

1 trailer
1 51 T ACME Skimmer
1,300' of 43" Expandi boom
492' of 30" Expandi boom

Figure III.A.4.b.iii-2 Oil Spill Recovery Equipment
Central and Northern California

iv. Oil Spill Trajectory Results: Oil spill trajectory simulations were conducted keeping track of the frequency with which trajectories intersected the locations of biological and recreational resources. Trajectories were recorded as impacting a resource only in cases where the resource was listed as being vulnerable to oil spill in the month the impact took place. Potential launch points for platforms, tanker segments and pipeline segments within the potential Sale No. 48 (and related activity) were analyzed. Five hundred potential spills were tracked from each point and the worst possible impact (60 days) was analyzed. Worst possible impact means that if a spill has not impacted a resource within 60 days, it will probably have weathered to the point where there is no detectable oil left. Segments and categories with an overall probability of impact of less than 5 percent were dropped to simplify the analysis. For those segments and categories remaining that do show a potential significant impact, a detailed analysis was conducted. The general analysis follows. For more specific impacts, refer to the appropriate impact section of interest.

Southern California. The oil spill trajectory model shows that a spill from proposed Sale No. 48 area could have some degree of impact on all shoreline segments within the Southern California Bight. Table III.A.4.b.iv-1 shows worst case impacts from proposed Sale No. 48 trajectories. Table III.A.4.b.iv-2 shows worst case impacts from potential tanker segment trajectories. Table III.A.4.b.iv-3 shows worst case impacts from potential pipeline segment trajectories. Table III.A.4.b.iv-4 shows worst case impacts from existing Federal leases assuming that they all had maximum development. The total probability of a 1,000 barrel or greater oil spill impacting each shoreline segment as a result of Federal leases is shown in Table III.A.4.b.iv-5. Also, shown on this table, is the total probability of a 1,000 barrel or larger spill resulting from impacts of foreign oil and Alaskan oil. A similar set of tables showing worst case impacts on offshore resource categories is shown in Tables III.A.4.b.iv-6 through 10. A detailed analysis of each shoreline segment follows (for overview see Figure III.A.4.b.i-27).

Mexico. Using the same methodology as in Southern California above, impacts in Mexican waters are indicated on Shoreline Segment No. 20, Guadalupe Island (55), Isla Cedros (57), and the Los Coronados (59). Tables III.A.4.b.lv-11 through 13 show worst case impacts from the various types of possible oil spills.

Central and Northern California. Using the same methodology as in Southern California above, impacts are indicated on Shoreline Segment Nos. 33, 38, 39, 40, 41, 42, and 43. Tables III.A.4.b.iv-11 through 13 show worst case impacts from the various types of possible oil spills.

Shoreline Segment No. 21 (San Diego County)

Table III.A.4.b.iv-1

WORST CASE (60 DAYS) SALE NO. 48 PLATFORM IMPACT
SOUTHERN CALIFORNIA[1]

Land Segment		Santa Barbara Channel									Santa Rosa	Santa Barbara Island		Tanner/Cortes				San Pedro		Dana Point/San Diego				
		P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	P-16	P-17	P-18	P-19	P-20	P-21	P-22	P-23
Segment No.	(21)																	9	11	9	6	18	22	24
Segment No.	(22)																		7	14	18	18	20	13
Segment No.	(23)																		10	24	45	35	8	5
Segment No.	(24)																			6				
Segment No.	(25)																	10	5					
Segment No.	(26)																	6						
Segment No.	(27)											6												
Segment No.	(28)								5															
Segment No.	(29)								14															
Segment No.	(30)						7		5															
Segment No.	(31)				8																			
Segment No.	(32)																							
San Miguel Island	(47)	27	38	10	8	7	6																	
Santa Rosa Island	(48)	5	21	37	11	17	9	6																
Santa Cruz Island	(49)			24	48	53	57	76	23	28		6												
Anacapa Island	(50)								18	43														
San Nicolas Island	(51)										19	7	10											
Santa Barbara Island	(52)											14	18											
Santa Catalina Island	(53)											12	6					25	25	18	11	7		
San Clemente Island	(54)										8	12	18	10	9	12	7	5						
Begg Rock	(60)										11													

[1]Conditional probability assuming that a spill has occurred.

Table III.A.4.b.iv-2

WORST CASE (60 DAYS) TANKER IMPACT
SOUTHERN CALIFORNIA[1]

Land Segment	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12	T-13	T-14	T-15	T-16	T-17	T-18	T-19	T-20	T-21	T-22	T-23	T-24	T-25	T-26	T-27
Segment No. (21)																									25	11	10
Segment No. (22)																									20	13	7
Segment No. (23)																									20	23	18
Segment No. (24)																											
Segment No. (25)																											10
Segment No. (26)								26												5				5			
Segment No. (27)							15	30																8			
Segment No. (28)							14	7																			
Segment No. (29)																											
Segment No. (30)																											
Segment No. (31)																											
Segment No. (32)				6						5	6																
San Miguel Island (47)				5	18					5																	
Santa Rosa Island (48)					22	7																					
Santa Cruz Island (49)					17	54	16																	6			
Anacapa Island (50)						15	18																				
San Nicholas Island (51)																			13		6	7	14	5			
Santa Barbara Island (52)																			5	6			8	6			
Santa Catalina Island (53)							5	10											5	37			6	29	7	21	22
San Clemente (54)														9					22	9	24	5	13	7			
Begg Rock (60)																						5	6				

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-3

WORST CASE (60 DAYS) PIPELINE IMPACT[1]

Land Segment		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8
Segment No.	(21)								
Segment No.	(22)								
Segment No.	(23)								
Segment No.	(24)								
Segment No.	(25)								
Segment No.	(26)								
Segment No.	(27)								
Segment No.	(28)								
Segment No.	(29)								
Segment No.	(30)								
Segment No.	(31)								
Segment No.	(32)								
San Miguel Island	(47)							29	9
Santa Rosa Island	(48)			10		16		20	27
Santa Cruz Island	(49)			14	27	37	58		44
Anacapa Island	(50)				34		16		
San Nicholas Island	(51)	12	24	9		6			
Santa Barbara Island	(52)			8					
Santa Catalina Island	(53)			5					
San Clemente Island	(54)	8	7	9		5			
Begg Rock	(60)	14	17						

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-4
WORST CASE (60 DAY) EXISTING LEASE IMPACT[1]

Land Segment		Santa Barbara Channel						Santa Rosa		Santa Barbara Island	Tanner/ Cortes		San Pedro	
		E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	E-11	E-12	E-13
Segment No.	(21)												10	13
Segment No.	(22)												6	6
Segment No.	(23)												8	8
Segment No.	(24)													
Segment No.	(25)												12	5
Segment No.	(26)												5	
Segment No.	(27)						5							
Segment No.	(28)													
Segment No.	(29)				5									
Segment No.	(30)													
Segment No.	(31)													
Segment No.	(32)	10												
San Miguel Island	(47)	11	22											
Santa Rosa Island	(48)	23	53	6	5			7		5				
Santa Cruz Island	(49)	25	5	63	31	67	25							
Anacapa Island	(50)			9	29	17	32							
San Nicholas Island	(51)							15	21	11				
Santa Barbara Island	(52)									16				
Santa Catalina Island	(53)									6			21	26
San Clemente Island	(54)							8	9	19	12	11		
Begg Rock	(60)							7	10					

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-5
TOTAL PROBABILITY OF 1000 bbl OR GREATER OIL SPILL[1]

Land Segment		FEDERAL LEASES EXISTING			FEDERAL LEASES PROPOSED			FEDERAL LEASES COMBINED			IMPORTS
		Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Alaskan & Foreign
Segment No.	(21)	10	10	12	8	8	9	17	17	20	4
Segment No.	(22)	6	6	7	5	5	6	11	11	13	2
Segment No.	(23)	7	7	9	6	6	7	13	13	16	2
Segment No.	(24)	2	2	3	1	1	2	4	4	4	
Segment No.	(25)	11	11	12	6	6	6	16	16	17	3
Segment No.	(26)	37	37	20	22	22	11	51	51	29	23
Segment No.	(27)	51	52	27	31	31	15	66	67	38	32
Segment No.	(28)	26	27	12	15	15	7	37	38	18	16
Segment No.	(29)	5	5	2	3	3	1	8	8	3	1
Segment No.	(30)	4	4	3	3	2	2	7	6	4	3
Segment No.	(31)	5	5	5	1	1	1	6	6	5	2
Segment No.	(32)	15	14	13	5	5	4	19	18	16	24
San Miguel Island	(47)	25	24	21	14	14	11	36	35	30	29
Santa Rosa Island	(48)	38	38	31	19	18	14	50	49	41	26
Santa Cruz Island	(49)	75	70	51	53	49	33	88	85	67	52
Anacapa Island	(50)	44	45	25	23	24	11	56	58	33	24
San Nicholas Island	(51)	21	23	14	12	13	8	31	33	22	18
Santa Barbara Island	(52)	9	11	11	5	6	6	14	17	16	8
Santa Catalina Island	(53)	33	34	42	22	22	26	48	49	57	27
San Clemente Island	(54)	28	30	38	16	17	22	40	42	51	27
Begg Rock	(60)	15	16	7	8	9	4	23	24	11	10

[1] Conditional probability assuming that a spill has occurred.

Table III.A.4.b.iv-6

WORST CASE (60 DAYS) SALE NO. 48 IMPACT
SOUTHERN CALIFORNIA[1]

Resource Category		Santa Barbara Channel									Santa Rosa	Santa Barbara Island		Tanner/Cortes				San Pedro		Dana Point/San Diego				
		P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	P-10	P-11	P-12	P-13	P-14	P-15	P-16	P-17	P-18	P-19	P-20	P-21	P-22	P-23
Tanner/Cortes Bank	(1)	18	12	7	5	5					27	9	10	79	100	33	87							
Ranger Bank	(2)															7	5							
Major commercial marketfish	(3)	81	100	48	82	62	93	97	100	100	83	82	100	93	100	68	87	55	73	88	99	89	100	100
Major commercial pelagic fish	(4)	22	16	23	81	41	100	57	100	100	65	81	86	82	95	59	84	100	100	70	43	55	72	80
Commercial salmon	(5)																							
Commercial albacore	(6)	19	13	8	7	5	5				22	7	7	31	39	31	46							10
Commercial bonito	(7)				11	5	9		19	10	5	11	8					8	10	9	9	23	36	27
Commercial tuna	(8)								7		7			12	14	17	15							9
Commercial swordfish	(9)											11	13		6	6	5	21	25	20	11	8	7	26
Commercial shellfish	(10)	59	77	90	93	96	94	100	97	100	51	75	77	50	67	47	68	68	69	73	91	92	90	90
Seabirds (Apr-Jun)	(11)	20	24	26	22	25	10	6	17	22	18	20	24					25	21	7				
Seabirds (Jul-Sep)	(12)		24		6																			
Seabirds (Oct-Dec)	(13)								27	7		5						26	14	6				
Seabirds (Jan-Mar)	(14)	7	5		9	6	17	12	26	17	27	6	5	26	7	25								
Rockfish, kelpbass, seabass, lingcod, etc.	(15)	58	78	88	86	91	88	90	96	97	70	90	92	60	70	42	67	100	97	97	91	94	98	96
Striped marlin, swordfish, albacore, etc.	(16)										5			9	13	13	15	9	22	36	37	21	35	35
Salmon sportfishing	(17)																							

[1]Conditional probability assuming that a spill has occurred.

Table III.A.4.b.iv-7
WORST CASE (60 DAYS) TANKER IMPACT
SOUTHERN CALIFORNIA[1]

Resource Category	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12	T-13	T-14	T-15	T-16	T-17	T-18	T-19	T-20	T-21	T-22	T-23	T-24	T-25	T-26	T-27
Tanner/Cortes Bank (1)	7	14	21	27	12					6	21	28	41	77				25	19		33	40	16	5			
Ranger Bank (2)																											
Major commercial marketfish (3)	29	32	40	61	83	96	66	22	72	80	56	46	53	84				31	82	60	82	67	84	59	90	85	65
Major commercial pelagic fish (4)	7	15	21	92	28	99	100	100	14	15	21	30	46	75				27	80	96	80	53	74	93	66	79	100
Commercial salmon (5)	7								22	11	6																
Commercial albacore (6)	41	32	35	28	12				9	8	23	42	44	36			25	43	11		17	36	13				
Commercial bonito (7)						8	9	5												7			8	9	30	9	9
Commercial tuna (8)			6	7							6	8	12	14				8	6		9	10					
Commercial sword-fish (9)							12	7						5					9	23	7		5	21	8	20	20
Commercial shell-fish (10)	18	16	21	35	77	97	81	88	57	40	36	27	32	47			6	21	67	67	61	39	66	68	90	73	73
Seabirds (Apr-Jun) (11)				6	23	13	14			9									17	20	15	5	25	18		6	20
Seabirds (Jul-Sep) (12)					10														5		9						
Seabirds (Oct-Dec) (13)						5	15	19												6				8		5	19
Seabirds (Jan-Mar) (14)				6	6	22	7					6	13	16				5	9		10	18	14				
Rockfish, kelpbass, bass, lingcod, etc. (15)	23	18	20	33	76	91	97	99	91	57	29	25	33	51				19	77	97	70	49	79	94	97	95	99
Striped marlin, swordfish, albacore, etc. (16)												5	8	10				5	6		7	6			27	33	16
Salmon sportfishing (17)									11																		

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-8
WORST CASE (60 DAYS) PIPELINE IMPACT [1]

Resource Category		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8
Tanner/Cortes Banks	(1)	49	22	13		10		14	
Ranger Bank	(2)								
Major commercial marketfish	(3)	92	87	81	73	58	92	76	44
Major commercial pelagic fish	(4)	73	65	61	100	34	84	20	26
Commerical salmon	(5)								
Commercial albacore	(6)	23	17	11		8		16	6
Commercial bonito	(7)		5	37	22	26	7		
Commercial tuna	(8)	11							
Commercial swordfish	(9)			20	6				
Commercial shellfish	(10)	48	50	76	96	87	99	74	95
Seabirds (Apr-Jun)	(11)	11	19	22	22	13	10	23	22
Seabirds (Jul-Sep)	(12)							13	
Seabirds (Oct-Dec)	(13)				10		10		
Seabirds (Jan-Mar)	(14)	20	22	15	16	12	18	5	
Rockfish, kelpbass, sea-bass, lingcod, etc.	(15)	71	78	87	98	92	95	72	92
Striped marlin, sword-fish, albacore, etc.	(16)	7							
Salmon sportfishing	(17)								

[1] Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-9
WORST CASE (60 DAY) EXISTING LEASE IMPACT[1]

Resource Category		SANTA BARBARA CHANNEL						SANTA ROSA		SANTA BARBARA ISLAND	TANNER/CORTES		SAN PEDRO	
		E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10	E-11	E-12	E-13
Tanner/Cortes Banks	(1)	9	6		5			26	21	10	81	100		
Ranger Bank	(2)											5		
Major commercial marketfish	(3)	84	47	100	100	100	100	93	84	90	94	100	71	73
Major commercial pelagic fish	(4)	30	11	100	100	100	100	62	69	82	87	100	100	100
Commerical salmon	(5)													
Commercial albacore	(6)	9	7		5			22	19	6	30	30		
Commercial bonito	(7)	50		9	15	6	11	45	5	10			8	10
Commercial tuna	(8)							7	6		14	14		
Commercial swordfish	(9)						5			11	5	6	20	25
Commercial shellfish	(10)	98	93	96	96	100	97	56	56	77	49	49	74	67
Seabirds (Apr-Jun)	(11)	24	25	11	18	8	22	20	25	24			24	22
Seabirds (Jul-Sep)	(12)	15												
Seabirds (Oct-Dec)	(13)				24		16						19	14
Seabirds (Jan-Mar)	(14)	5		24	27	26	17	28	29	6	20	22		
Rockfish, kelpbass, seabass, lingcod, etc.	(15)	86	90	92	94	96	96	71	73	90	65	60	100	98
Striped marlin, swordfish, albacore, etc.	(16)							5	5		10	13	16	29
Salmon sportfishing	(17)													

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-10
TOTAL PROBABILITY OF 1000 bbl OR GREATER OIL SPILL[1]

Resource Category		FEDERAL LEASES EXISTING			FEDERAL LEASES PROPOSED			FEDERAL LEASES COMBINED			IMPORTS
		Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Alaskian & Foreign
Tanner/Cortes Banks	(1)	80	81	82	53	54	58	91	91	92	82
Ranger Bank	(2)	9	9	10	5	5	6	13	14	16	9
Major commercial marketfish	(3)	100	100	100	96	96	94	100	100	100	100
Major commercial pelagic fish	(4)	100	100	100	97	97	95	100	100	100	99
Commerical salmon	(5)	11	11	10	6	6	5	16	16	15	23
Commercial albacore	(6)	59	60	61	40	41	43	75	76	78	97
Commercial bonito	(7)	59	62	51	26	29	19	70	73	61	22
Commercial tuna	(8)	24	25	28	14	15	17	35	36	41	35
Commercial swordfish	(9)	40	43	43	26	28	27	55	59	58	29
Commercial shellfish	(10)	100	100	100	98	97	94	100	100	100	99
Seabirds (Apr-Jun)	(11)	66	67	63	42	44	38	80	82	77	53
Seabirds (Jul-Sep)	(12)	21	21	24	6	6	7	25	25	29	16
Seabirds (Oct-Dec)	(13)	55	54	38	34	33	22	70	70	52	30
Seabirds (Jan-Mar)	(14)	59	59	48	35	35	27	73	73	62	41
Rockfish, kelpbass, sea-bass, lingcod, etc.	(15)	100	100	99	98	98	96	100	100	100	100
Striped marlin, sword-fish, albacore, etc.	(16)	29	29	34	20	20	23	43	44	49	21
Salmon sportfishing	(17)	5	5	4	2	2	2	7	7	7	7

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-11

WORST CASE (60 DAY) SALE NO. 48 IMPACT[1]

		Tanner/Cortes				Dana Point/San Diego				
		P-13	P-14	P-15	P-16	P-19	P-20	P-21	P-22	P-23
MEXICO										
Shoreline Segment No.	20								16	12
Guadalupe Island	(55)									
Isla Cedros	(57)			6						
Los Coronados	(59)								15	29
CENTRAL & NORTHERN CALIF.										
Shoreline Segment No.	33									
Shoreline Segment No.	38									
Shoreline Segment No.	39									
Shoreline Segment No.	40									
Shoreline Segment No.	41									
Shoreline Segment No.	42									
Shoreline Segment No.	43									

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-12

WORST CASE (60 DAYS) TANKER IMPACT[1]

	T-1	T-2	T-4	T-9	T-10	T-11	T-17	T-25
MEXICO								
Shoreline Segment No. 20								7
Guadalupe Island (55)							10	
Isla Cedros (57)								
Los Coronados (59)								7
CENTRAL & NORTHERN CALIF.								
Shoreline Segment No. 33			5			8		
Shoreline Segment No. 38		5			17			
Shoreline Segment No. 39				6	15			
Shoreline Segment No. 40				10	6			
Shoreline Segment No. 41				12				
Shoreline Segment No. 42	8			30				
Shoreline Segment No. 43				20				

[1]Conditional probability assuming that a spill has occurred.

TABLE III.A.4.b.iv-13

TOTAL PROBABILITY OF 1000 BBL OR GREATER OIL SPILL[1]

	FEDERAL LEASES									IMPORTS
	EXISTING			PROPOSED			COMBINED			
	Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Mixed A	Mixed B	Tanker	Alaskian & Foreign
MEXICO										
Shoreline Segment No. 20	5	6	5	4	4	4	9	9	9	3
Guadalupe Island (55)	1	1	1	1	1	1	2	2	2	14
Isla Cedros (57)	7	8	9	4	5	5	11	12	14	7
Los Coronados (59)	5	6	6	4	4	5	9	10	10	3
CENTRAL & NORTHERN CALIF.										
Shoreline Segment No. 33	6	6	5	3	3	3	9	9	8	22
Shoreline Segment No. 38	5	5	5	3	3	3	8	8	7	16
Shoreline Segment No. 39	6	6	5	3	3	3	8	8	8	7
Shoreline Segment No. 40	4	4	4	2	2	2	7	7	6	2
Shoreline Segment No. 41	4	4	4	2	2	2	6	6	6	3
Shoreline Segment No. 42	8	8	8	5	6	4	13	13	12	17
Shoreline Segment No. 43	5	5	5	3	3	3	8	8	8	2

[1] Conditional probability assuming that a spill has occurred.

Significant areas within segment:
- Imperial Beach
- San Diego Bay
- San Diego City
- Point Loma
- Ocean Beach
- Point Medanos
- Mission Bay
- Pacific Beach
- Sweetwater River
- La Jolla
- Point La Jolla

Significant categories of impact:
- ASBS (San Diego-La Jolla Ecological Reserve, San Diego Marine Life Refuge)
- Marine Life Refuge (San Diego)
- Ecological Reserve (San Diego-La Jolla)
- Sensitive Biological Areas (Mission Bay, San Diego Bay, Tijuana Estuary)
- Rare and Endangered Species
  - Mission Bay (California least tern, light-footed clapper rail), California black rail
  - Sweetwater River (California least tern)
  - Imperial Beach (Beldings savannah sparrow)
  - San Diego Bay (California least tern, light-footed clapper rail)
- Kelp Beds
- Rocky Intertidal areas
- Sport fishing areas (Artificial fishing reef F19)
- Clam Beach (Imperial Beach)
- High Intensity Use Beaches (Pacific Beach, Ocean Beach, Sunset Cliffs, Point Loma, Ladera State Park, Coronado Beach, Silver Strand Beach, Beach State Park, Imperial Beach, Border Field State Park, La Jolla)
- Skin and scuba diving areas (Ocean Beach, Point Loma)
- Oceanarium (Sea World)
- Major commercial ports (Mission Bay, San Diego Bay)
- Marinas and harbors (San Diego Harbor)
- Recreational boating
- Several known monuments, landmark and historic sites
- Several known cultural resource sites

Local Sources of Hydrocarbons:
- Within this shoreline segment, the San Diego River is discharging an estimated 7 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
- Additionally, the Point Loma sewage outfall (3200 meters from shore at a depth of 64 meters) is discharging

an estimated 80 barrels per day of oil and grease (Figure III.A.4.a.vii-2).

Shoreline Segment No. 22 (San Diego County)

Significant areas within segment:

- Torrey Pines
- Del Mar
- San Dieguito River
- Solana Beach
- San Elijo Lagoon
- Cardiff By The Sea
- Encinitas
- Leucadia
- Batiquitos Lagoon
- Los Penasquitos Lagoon
- Aqua Hedionda Lagoon
- Carlsbad
- Buena Vista Lagoon
- Oceanside
- San Luis Rey River

Significant categories of impact:

- ASBS (San Diego Marine Life Refuge)
- Marine Life Refuge (San Diego)
- Ecological Reserve (Buena Vista Lagoon)
- Sensitive Biological areas (San Elijo Lagoon)
- Rare and Endangered species:
  - Batiquitos Lagoon (California least tern)
  - San Elijo Lagoon (California least tern, Beldings savannah sparrow)
  - Del Mar (California least tern)
  - Los Penasquitos Lagoon (California least tern, light-footed clapper rail, Beldings savannah sparrow)
  - Aqua Hedionda Lagoon (California least tern, Beldings savannah sparrow)
  - Buena Vista Lagoon (California least tern)
- Kelp beds
- Sport fishing areas (Artificial fishing reefs F18, F17)
- High Intensity Use Beaches (Leucadia State Beach, Seacliff County Park, Encinitas, Cardiff Beach State Park, Torrey Pines, South Carlsbad State Beach, Ponto Beach State Park, San Elijo, Cardiff By The Sea, Solana Beach, Carlsbad State Beach, Moonlight State Beach, Leucadia Beach State Park, San Dieguito Bluffs, Ecke Beach, Oceanside Beach)

Skin & Scuba diving areas (Leucadia, Encinitas, Cardiff By The Sea)
Oceanarium (Scripps Aquarium)
Recreational boating area
Several known cultural resource sites

Shoreline Segment No. 23 (San Diego County)

Significant areas within segment:
- Santa Margarita River
- San Mateo Point
- San Clemente

Significant categories of impact:
- Rare and Endangered Species
  - Santa Margarita River (California least tern)
- Sensitive biological area (San Mateo Creek)
- Sport fishing area
- Clam Beaches
- High Intensity Use Beaches (San Clemente State Beach, San Onofre State Beach)
- Skin and Scuba Diving areas
- Marinas and harbors (Santa Margarita River)
- Recreational boating area
- Several known cultural resource sites

Local sources of hydrocarbons:
- Just above the northern boundary of this shoreline segment, San Juan Creek is discharging an estimated 2 barrels per day of oil and grease into the near shore environment, a portion of which will reach the above areas (Figure III.A.4.a.vii-1).

Shoreline Segment No. 24 (Orange County)

Significant areas within segment:
- Doheny Park
- San Juan Capistrano
- Dana Point
- Laguna Beach
- Newport Beach
- Costa Mesa
- Santa Ana River

Significant categories of impact:
- ASBS (Irvine Coast and Newport Beach Marine Life Refuge)
- Marine Life Refuges (Irvine Coast, Laguna Beach, South

Laguna Beach, Niguel, Dana Point, Doheny Beach, Newport Beach)

Ecological Reserves (Heisler Park, Upper Newport Bay)

Rare and Endangered Species

Upper Newport Bay (Light-footed clapper rail, Beldings savannah sparrow, California black rail)

Kelp beds

Rocky Intertidal areas

Sport fishing areas (Artificial fishing reefs F15, F16)

Clam beach (Newport Beach)

High Intensity Use beaches (Laguna Beach, Dana Cove, Dana Point, Corona Del Mar State Beach, South Laguna Beach, Doheny State Beach, Three Arch Bay, Newport Beach, Niguel Beach, Aliso County Beach, Balboa Beach)

Skin and Scuba diving areas

Marinas and harbors (Dana Cove, Doheny State Beach, Newport Beach, Balboa Bay)

Recreational boating areas

Known monuments, landmarks and historic sites

Known cultural resource sites

Local source of hydrocarbons:

Within this shoreline segment, the San Juan Creek is discharging an estimated 2 barrels per day of oil and grease Figure III.A.4.a.vii-1)

Additionally, the Orange County Sewage outfall (8300 meters from shore at a depth of 60 meters) is discharging an estimated 201 barrels per day of oil and grease (Figure III.A.4.a.vii-2).

The Santa Ana River is also discharging an estimated 1 barrel per day of oil and grease (Figure III.A.4.a.vii-1).

<u>Shoreline Segment No. 25</u> (Orange and Los Angeles Counties)

Significant areas within segment:

Huntington Beach

Seal Beach

Long Beach Harbor

Los Angeles Harbor

Wilmington

San Pedro

Significant categories of impact:

Ecological Reserve (Bolsa Chica)
National Wildlife Refuge (Seal Beach)
Rare and Endangered Species
Anaheim Bay (Light-footed clapper rail, Beldings savannah sparrow)
Sport fishing areas (Artificial fishing reefs F12, F13, F14)
Clam beaches (Huntington Beach, Long Beach)
High Intensity Use Beaches (Sunset Beach, Surfside Beach, Bolsa Chica State Beach, Seal Beach, Alimitos Beach, Royal Palms State Beach, Point Fermin Park)
Skin and Scuba diving areas
Marinas and harbors (Bolsa Chica, Seal Beach)
Recreational boating areas
Major Commercial Ports (Los Angeles Harbor, Long Beach Harbor, Seal Beach)
Known monuments, landmarks and historic sites

Local sources of hydrocarbons:
Within this shoreline segment, the Dominguez Channel is discharging an estimated 7 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
Los Angeles River is discharging an estimated 27 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
The San Gabriel River is discharging an estimated 3 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
Coyote Creek is discharging an estimated 9 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
Additionally, the Whites Point (JWPCP) sewage outfall (3 pipes of 2,000 meters, 2,600 meters and 3,600 meters at depths of 50, 65 and 60 meters respectively) discharging an estimated 596 barrels per day of oil and grease (Figure III.A.4.a.vii-2)

Note: The combined total of the discharges discussed above is 642 barrels per day.

It should also be noted that in the center of this segment are the Wilmington, Belmont and Huntington Beach offshore fields in State tideland waters (see Section III.A.4.a.vi) with a calculated 612 million barrels of oil remaining which could result in 2.5 spills of 1,000 barrels or more during the next 22 years in addition to a number

of smaller and chronic spills.

Shoreline Segment No. 26 (Los Angles County)

Significant areas within segment:
- Point Fermin
- Point Vicente
- Palos Verdes Point
- Redondo Beach
- Hermosa Beach
- Manhattan Beach
- Marina Del Rey
- Playa Del Rey
- Santa Monica
- Ballona Creek

Significant categories of impact:
- Marine Life Refuge (Point Fermin)
- Sensitive Biological area (Ballona Creek)
- Rare and Endangered Species
  - Playa Del Rey (California least tern)
- Kelp beds
- Rocky Intertidal areas
- Sport fishing areas (Artificial fishing reefs F6, F7, F8, F9, F10, F11)
- High Intensity Use Beaches (Venice Beach, Hermosa Beach, Cabrillo Beach, Dockweiler State Beach, Torrance Beach, Redondo Beach, Manhattan State Beach, Point Vicente Park, Santa Monica State Beach, Will Rogers State Beach)
- Skin and Scuba diving areas (Point Vicente, Point Fermin)
- Oceanarium (Marineland)
- Marinas and harbors (Cabrillo, Redondo, Playa Del Rey)
- Recreational boating areas
- Known monument, landmark, historic sites
- Known cultural resource sites

Local sources of hydrocarbons:
- Within this shoreline segment, the Pico drain is discharging an estimated 5 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
- Ballona Creek is discharging an estimated 22 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
- At the Hyperion outfall, one of the lines 8000 meters from shore (depth of 60 meters) is discharging an estimated 194 barrels per day of oil and grease

and the other line 11,000 meters from shore (depth of 100 meters) is discharging an estimated 75 barrels per day (Figure III.A.4.a.vii-2)

Note: The combined total of the discharges discussed above is 296 barrels per day.

In addition to the above, the 596 barrel per day discharge at Whites Point discussed under Line Segment No. 25 is immediately adjacent to the southern portion of this segment and a significant portion of the discharge will at times go into Shoreline Segment No. 26.

There is also a known natural oil seep in the middle of this segment discharging an estimated 50 barrels per day of crude oil (Figure III.A.4.a.vii-1)

<u>Shoreline Segment No. 27</u> (Los Angeles County)

Significant areas within segment:
- Malibu Point
- Point Dume

Significant categories of impact:
- ASBS (Point Dume)
- Kelp beds
- Sports fishing areas (Artificial fishing reefs F4, F5)
- Clam beaches (Point Dume, Malibu Point)
- High Intensity Use Beaches (Zuma Beach, Malibu State Beach, Westward Beach, Las Tunas State Beach, Escondido Beach, Point Dume State Beach, Topanga Beach, Coral State Beach)
- Skin and scuba diving areas (Malibu Point, Point Dume)
- Marinas and harbors (Point Dume)
- Recreational boating areas
- Known cultural resource sites

Local sources of hydrocarbons:
- Within this segment, Malibu Creek is discharging an estimated 1 barrel per day of oil and grease (Figure III.A.4.a.vii-1).

<u>Shoreline Segment No. 28</u> (Ventura County)

Significant areas within segment:

Laguna Point
Point Mugu
Port Hueneme

Significant categories of impact:
- ASBS (Laguna Point, Point Mugu)
- Sensitive Biological areas (Mugu Lagoon, Port Hueneme)
- Rare and Endangered Species
    - Point Mugu (California least tern, Belding savannah sparrow))
- Kelp beds
- Sport fishing areas
- High Intensity Use Beaches (Ormond Beach, Point Mugu State Park, Leo Carillo State Beach)
- Skin and scuba diving areas
- Major Commercial Port (Port Hueneme Harbor)
- Marinas and harbors (Port Hueneme Harbor)
- Recreational boating area
- Known monument, landmark, historic sites
- Known cultural resource sites

Local sources of hydrocarbons:
- Within this shoreline segment, Callequas Creek is discharging an estimated 2 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
- At Oxnard outfall, a line 1750 meters from shore at a depth of 16 meters, is discharging an estimated 6 barrels per day of oil and grease (Figure III.A.4.a.vii-2)

<u>Shoreline Segment No. 29</u> (Ventura County)

Significant areas within segment:
- Oxnard
- Point Hueneme
- Santa Clara River
- Ventura
- Point Las Pitas
- Punta Gorda
- Rincon Point
- Carpinteria

Significant categories of impact:
- Sensitive Biological Areas (Santa Clara River, McGrath Lake, Carpinteria, Carpinteria Marsh)
- Rare and Endangered Species

Carpinteria Marsh (Light-footed clapper rail, Beldings savannah sparrow)
Kelp beds
Sport fishing areas (Artificial reefs F1, F2, F3)
High Intensity Use Beaches (Hobgon Park, San Buenaventura State Beach, Mandalay Beach, Silver Strand Beach, Faria Park, Oxnard Beach, Carpinteria State Beach, Emma Wood State Beach, McGrath State Beach, Hollywood Beach, Rincon Point, Summerland Beach)
Skin and scuba diving areas
Major Commercial port (Ventura Harbor)
Recreational boating areas
Known cultural resource sites

Local sources of hydrocarbons:
Within this shoreline segment, the Ventura River is discharging an estimated 2 barrels per day of oil and grease (Figure III.A.4.a.vii-1)
The Santa Clara River is also discharging an estimated 1 barrel per day of oil and grease (Figure III.A.4.a.vii-1)
It should be noted that this segment represents approximently 1/8 of the shoreline areas of the Santa Barbara Channel. Within the Channel there is normally between 40 to 670 barrels of oil that occurs due to natural seepage each day.

It should also be noted that in this segment are the Summerland, Carpinteria and Rincon offshore fields in State tideland waters (see Section III.A.4.a.vi) with a calculated 15,652,000 barrels of oil remaining which could result in 0.07 spills of 1,000 barrels or more during the next 22 years in addition to a number of smaller and chronic spills.

Shoreline Segment No. 30 (Santa Barbara County)

Significant areas within segment:
Santa Barbara
Santa Barbara Point
Goleta
Goleta Point
Coal Oil Point
Naples

Significant categories of impact:

Sensitive biological areas (Standard Oil Co. Pier, Santa Barbara, Burma/Naples Beach, Goleta Slough, Goleta Rocks)

Rare and Endangered Species

Goleta Slough (Light-Footed clapper rail, Beldings savannah sparrow)

Pinnipeds

Kelp beds

Rocky intertidal areas

Sport fishing areas

High Intensity Use Beaches (Arroyo Burro Beach, Shoreline Park, Montecito City Beach, Goleta State Beach, Ellwood Pier)

Skin and scuba diving areas

Major Commercial Port (Santa Barbara Harbor)

Marinas and harbors (Santa Barbara Harbor)

Recreational boating areas

Oceanarium (USCB Marine Laboratory)

Known cultural resource sites

Local sources of hydrocarbons:

Within this shoreline segment, the Santa Barbara Creek is discharging an estimated 2 barrels per day of oil and grease (Figure III.A.4.a.vii-1)

In approximately the center of this segment, the natural oil seep at Coal Oil Point is discharging an approximate 200 barrels a day of crude oil which is a part of the overall 20 to 670 barrels of natural seepage occurring within the Santa Barbara Channel.

Also the Ellwood offshore field in State tideland waters (see Section III.A.4.a.vi) with a calculated 5,420,000 barrels of oil remaining which could result in 0.02 spills of 1,000 barrels or more during the next 22 years in addition to a number of smaller and chronic spills.

<u>Shoreline Segment No. 31</u> (Santa Barbara County)

Significant areas within segment:

Orelle

Gaviota

San Augustin

Significant categories of impact:

Kelp beds
Sport fishing areas
Clam beaches
High Intensity Use Beaches (Refugio State Beach, El Capitan State Beach, Gaviota State Park)
Skin and scuba diving areas (Orelle, El Capitan, Gaviota)
Recreational boating areas
Known cultural resource sites

Local sources of hydrocarbons:
Within this shoreline segment, the Alegria offshore field in State tideland waters (see Section III.A.4.a.vi) with a calculated 100,000 barrels of oil remaining which could result in a (but improbable) large spill of more than 1,000 barrels; however, there could be a number of smaller spills.
This shoreline segment also occupies approximately 1/8 of the shoreline area of the Santa Barbara Channel within which between 40 to 670 barrels per day of crude oil is discharged by natural seeps.

Shoreline Segment No. 32 (Santa Barbara County)

Significant areas within segment:
Point Conception
Point Arguello
Surf
Santa Ynez River

Significant categories of impact:
Sensitive biological area (Point Conception)
Rare and Endangered Species
Santa Ynez River (California least tern)
Pinnipeds
Kelp beds
Rocky intertidal areas
Sport fishing areas
High Intensity Use Beach (Jalama Beach)
Recreational boating areas
Known cultural resource sites

Shoreline Segment No. 47 - San Miguel Island (Santa Barbara County)

Significant areas within segment:
Richardson Rock

Wilson Rock
Point Bennett
Harris Point
Prince Island
Cardwell Point

Significant categories of impact:
- The island is an ASBS
- Rare and Endanagered Species (Island fox, California least tern)
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas
- Sport fishing areas
- Skin and scuba diving area

Local sources of hydrocarbons:

This shoreline segment occupies approximately 1/8 of the shoreline area of the Santa Barbara Channel within which between 40 to 670 barrels per day of crude oil is discharged by natural seeps.

Shoreline Segment No. 48 - Santa Rosa Island (Santa Barbara County)

Significant areas within segment:
- Carrington Point
- East Point
- South Point
- Bee Rock
- Sandy Point
- Beckers Beach
- Cluster Point

Significant categories of impact:
- The island is an ASBS
- Rare and Endangered Species (Island Fox)
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky Intertidal areas
- Sport fishing areas
- Skin and scuba diving areas
- Recreational boating area

Local sources of hydrocarbons:

This shoreline segment occupies approximatley 1/8 of the shoreline area of the Santa Barbara Channel within which between 40 to 670 barrels per day of crude oil is discharged by natural seeps.

Shoreline Segment No. 49 - Santa Cruz Island (Santa Barbara County)

Significant areas within segment:
- West Point
- Diablo Point
- Chinese Harbor
- San Pedro Point
- Bowen Point
- Gull Island
- Kinton Point

Significant categories of impact:
- The island is an ASBS
- Rare and Endangered Species (Island Fox)
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas
- Sport fishing areas
- Skin and scuba diving areas
- Recreational boating area

Local sources of hydrocarbons:
This shoreline segment occupies approximately 1/8 of the shoreline area of the Santa Barbara Channel within which between 40 to 670 barrels per day of crude oil is discharged by natural seeps.

Shoreline Segment No. 50 - Anacapa Island (Ventura County)

Significant categories of impact:
- The island is an ASBS
- Rare and Endangered Species (California brown pelican)
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas
- Sport fishing areas
- Skin and scuba diving areas
- Recreational boating area
- Known monument, landmark and historic sites

Local sources of hydrocarbons:

This shoreline segment occupies approximately 1/8 of the shoreline area of the Santa Barbara Channel within which between 40 to 670 barrels per day of crude oil is discharged by natural seeps.

Shoreline Segment No. 51 - San Nicolas Island (Ventura County)

Significant categories of impact:

- The island is an ASBS
- Rare and Endangered Species (Island fox)
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas
- Sport fishing area
- Known monument, landmark, historic sites

Shoreline Segment No. 52 - Santa Barbara Island (Santa Barbara County)

Significant categories of impact:

- The island is an ASBS
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas
- Sport fishing area
- Skin and scuba diving area
- Recreational boating area
- Known monument, landmark, historic sites

Shoreline Segment No. 53 - Santa Catalina Island (Los Angeles County)

Significant areas within segment:

- West End
- Isthmus Cove
- Long Point
- Avalon
- Little Harbor
- Catalina Harbor
- Farnsworth Bank

Significant categories of impact:

- The island is an ASBS
- Ecological Reserve (Farnsworth Bank, Lovers Cove)

Rare and Endangered Species (Island fox)
Seabird breeding and nesting area
Pinnipeds
Kelp beds
Rocky intertidal areas
Sport fishing area
Skin and scuba diving area
Marinas and harbors (Avalon)
Oceanarium (USC Marine Laboratory)

Shoreline Segment No. 54 - San Clemente Island (Los Angeles County)

Significant areas within segment:
North West Harbor
Wilson Cove
NOTS Pier
Eel Point
China Point
Pyramid Point

Significant categories of impact:
The island is an ASBS
Rare and Endangered Species (Island fox)
Seabird breeding and nesting area
Pinnipeds
Kelp beds
Rocky intertidal areas
Sport fishing area

Shoreline Segment No. 60 - Begg Rock (Ventura County)

Significant categories of impact:
It is an ASBS
Sport fishing area

Shoreline Segment No. 20 (Mexico)

Significant areas within segment:
Tijuana
Punta Descanso

Significant categories of impact:
Sport fishing
Recreational boating
Several known cultural resource sites

Local sources of hydrocarbons:

Within this shoreline segment lies the PEMEX storage plant in Rosarito. Two or three tankers per month (unloadings vary from 20,000 bbls to 120,000 bbls each) tie up at the offshore loading buoy then attach to the 150 foot (five 30 foot sections) rubber hose and discharge into the 1600 meter, 20 inch diameter pipeline to shore. Normally a pressure of 7 kg/m2 is maintained, resulting in a flow of 3,000 to 5,000 barrels per hour. This unloading facility is suspected of being the source of much of the local oil pollution observed on the surrounding beaches (Higuera, Borrego, 1974).

<u>Shoreline Segment No. 55</u> - Isla Guadalupe (Mexico)

Significant areas within segment:
- North Point
- Steamer Point
- West Anchorage
- South Bluff
- Outer Island

Significant categories of impact:
- Rare and Endangered species (Guadalupe fur seal)
- Seabird breeding and nesting area
- Pinnipeds
- Rocky intertidal areas

<u>Shoreline Segment No. 57</u> - Isla Cedros (Mexico)

Significant areas within segment
- Cabo San Augustin
- Punta Morro Redondo

Significant categories of impact:
- Sensitive biological area
- Seabird breeding and nesting area
- Pinnipeds
- Kelp beds
- Rocky intertidal areas

<u>Shoreline Segment No. 59</u> - Los Coronados Islands (Mexico)

Significant categories of impact:
- It is a sensitive biological area

Seabird breeding and nesting area
Pinnipeds
Kelp beds
Sport fishing
Known cultural resource site
Skin and scuba diving area

<u>Shoreline Segment No. 33</u> (Santa Barbara County)

Significant areas within segment:
Purisima Point
Point Sal
Santa Maria
Guadalupe
Santa Maria River

Significant categories of impact:
Pinnipeds (Point Sal)
Rocky intertidal areas
Sport fishing areas
High Intensity Use Beaches (Point Sal State Beach)
Known monument, lankmark, and historic site

<u>Shoreline Segment No. 38</u> (Monterey County)

Significant areas within segment:
Big Sur River
Point Sur

Significant categories of impact:
Marine Life Refuge (John Little State Reserve)
Rare and Endangered Species (The entire segment is a Sea Otter Game Refuge)
Seabird breeding and nesting area
Kelp beds
Rocky intertidal areas
High Intensity Use Beaches (Julia Pieffer Burns State Park, Pieffer Beach, Andrew Molera State Park)

<u>Shoreline Segment No. 39</u> (Monterey County)

Significant areas within segment:
Hurricane Point
Point Lobos
Carmel River
Carmel

Cypress Point
Monterey

Significant categories of impact:
- ASBS (Big Sur, Point Lobos State Reserve)
- Rare and Endangered Species (The entire segment is a Sea Otter Game refuge)
- Seabird breeding and nesting (Point Lobos, Point Sur)
- Pinnipeds (Point Lobos)
- Kelp beds
- Rocky intertidal areas
- Sport fishing areas
- High Intensity Use Beaches (Point Lobos State Reserve, Carmel River State Beach, Carmel City Beach, Shoreline Park, Asilomar State Beach)
- Skin and scuba diving area (Point Lobos, Carmel, Monterey)
- Oceanarium (CFG Mariculture Center)

<u>Shoreline Segment No. 40</u> (Monterey & Santa Cruz Counties)

Significant areas within segment:
- Point Pinos
- Monterey Bay
- Moss Landing
- Watsonville
- Santa Cruz
- Point Anos

Significant categories of impact:
- ASBS (Hopkins Marine Life Refuge)
- Sensitive biological areas (San Lorenzo River, Watsonville Slough, Elkhorn Slough, Salinas River)
- Rare and Endangered Species
  - Moss Landing (Light-footed clapper rail)
  - Santa Cruz (Long-toed salamander)
  - Seabird breeding and nesting (Point Lobos, Point Anos)
  - Pinnipeds (Point Anos, Monterey, Cypress Point)
  - Oceanariums (UCSC Marine Laboratory, Hopkins Marine Laboratory)
  - Kelp beds
  - Rocky intertidal areas
  - Sport fishing areas
  - Clam beaches (Monterey Bay, Moss Landing)
  - High Intensity Use Beaches (Natural Bridges State Beach, Twin Lakes State Beach, New Brighton State Beach, Manresa State Beach, Zmudowski

State Beach, Santa Cruz Beach, Capitola Beach, Sunset State Beach, Salinas River State Beach)

Skin and Scuba diving areas (Cypress Point, Point Anos)

Major commercial port (Moss Landing Harbor)

Marinas and harbors (Moss Landing Harbor, Capitola Beach)

Recreational boating area

Known monument, landmark, and historic site

Shoreline Segment No. 41 (Santa Cruz County)

Significant areas within segment:

Davenport
Ana Nuevo Bay
Ana Nuevo Island
Point Ana Nuevo
Pigeon Point

Significant categories of impact:

ASBS (Ana Nuevo)
Pinnipeds (Ana Nuevo Island, Ana Nuevo Bay, Pigeon Point)
Kelp beds
Rocky intertidal areas
Sport fishing area
Clam beaches (Point Ana Nuevo, Ana Nuevo Bay)
High Intensity Use Beaches (Ana Nuevo State Reserve)
Known monument, landmark, historic site

Shoreline Segment No. 42 (San Mateo County)

Significant areas within segment:

Pescadero Point
Martins Beach
Half Moon Bay
Palo Alto
Redwood City
Point Montara

Significant categories of impact:

ASBS (James Fitzgerald)
Marine Life Refuge (James Fitzgerald)
Sensitive biological area (Pescadero Creek)
Seabird breeding and nesting area
Pinnipeds (Pigeon Point)
Kelp beds

Rocky intertidal areas
Sport fishing
High Intensity Use Beaches (Half Moon Bay State Beach, San Gregorio State Beach, Pomponio State Beach, Pescadero State Beach, Bean Hollow State Beach)
Marinas and harbors (Half Moon Bay)
Recreational boating areas
Known monument, landmark, historic site

<u>Shoreline Segment No. 43</u> (San Mateo County)

Significant areas within segment:
Point San Pedro
San Francisco
San Francisco Bay
Point Bonita

Significant categories of impact:
Pinnipeds (Point San Pedro)
Kelp beds
Rocky intertidal areas
Sport fishing area
High Intensity Use Beaches (Sharp Park, Marin Headlands State Park, Montara State Beach, Thorton State Beach, Golden Gate Park, Seal Rocks State Beach, Baker State Beach)
Oceanarium (Steinhart Aquarium)
Recreational boating area
Major commercial ports (San Francisco, Oakland Harbor, Richmond Harbor)
Known monument, landmark, historic site

v. Preliminary Implications: The oil spill trajectory model indicates a wide range of impacts from insignificant to quite significant on a large number of shoreline segments and at sea resource categories. It also shows that if offshore development does not occur, a similar impact will occur from the oil that must be imported in its place. If the oil and gas equivalent were tankered into the area, 3.37 spills of 1,000 barrels, or greater, are expected to occur. It is also apparent that there is a great deal of hydrocarbons being discharged into the Southern California Bight from surface runoff, sewage outfalls and natural causes. It appears, then, that primary emphasis to minimize environmental impact as a result of oil spills would not be to eliminate tracts or tract groupings from the potential Lease Sale No. 48, but to concentrate on safety and mitigating measures such as an adequate oil spill response capability.

c. Collisions Resulting from Conflicts Between Ship Navigation and Offshore Structures: Impacts resulting from collisions between ships and offshore structures could result in loss of human lives, personal injuries, oil spills, and property damage.

Figure III.A.3-1 illustrates several proposed Sale No. 48 tracts that are located inside and near the established and normally used shipping lanes. Offshore structures in these tracts would be a hazard to navigation. Table III.A.4.c-1 tabulates the ship collision records for the Southern California Bight area from 1967 to 1978. This table indicates that 7 platforms, which are located in Federal waters, had no ship collision record. Six of these platforms are in operation; one, Hondo, is under construction. This table also summarizes 10 ship collisions of which 4 occurred in the Santa Barbara Channel; and 6, in the San Pedro Channel.

FES Sale No. 35 includes a history on collision between ships and platforms in the Gulf of Mexico. These collisions are summarized in Table III.A.4.c-2. Between 1962 to 1975 there were 31 collisions. Since there are insufficient ship platform collision records in the Southern California Bight area, the collision record in the Gulf of Mexico was used to estimate the number of collisions for Sale No. 48 and for combined Sale No. 48 and existing Federal leases.

Table III.A.4.c-3 summarizes the estimates on collisions between ships and platforms as follows: Sale No. 48-31 platforms with operating time of 14 years, estimated 1.0 collision; combined Sale No. 48 and existing Federal leases - 86 platforms with time of 14 years, estimated 2.8 collisions.

John J. Mc Mullen Associates has indicated an increase of only 9 percent nominal traffic increase in Santa Barbara Channel through the year 2000. Therefore, the estimated 2.8 collisions for the combined projects could be applied to the cumulative shipping impacts from other projects and proposals listed previously in Chapter I.

d. Accidental Deaths and Injuries on Oil Industry Structures and Vessels: Information contained in the Pacific OCS Accident Reports by the U.S. Geological Survey for 1973 to 1978 records only the accidents associated with the petroleum activities in Federal waters. These reports indicate the following; one death during drilling vessel operation; 56 personal injuries, drilling vessel operation; 75 personal injuries, platform work; and 4 personal injuries, general.

FES Sale No. 35 summarizes the death record for the petroleum activities in Gulf of Mexico for 1964-1973. A total of 62 deaths occurred in the international waters from causes related to OCS oil and gas operations. Also, it was approximated that 9 deaths per year could be expected in the Gulf of Mexico as result of offshore activities in OCS waters.

Table III.A.4.c-1

SHIP COLLISIONS IN SOUTHERN CALIFORNIA BIGHT AREA

Dates	Collision Description	Location
[a]Between 1967-76	2 Collisions between ships	One in Santa Barbara Channel; one off Point Conception
"	1 Grounding	Outside of LA/LB breakwater
"	4 Collisions with pleasure craft (no damage to ship)	San Pedro Bay Channel
"	1 Collision with buoy	San Pedro Bay Channel
[b]Dec. 1976	1 Collision between ships	Port Hueneme
[b]Feb. 1978	1 Collision between fishing craft and ships	Santa Barbara Channel
[c]1967 to 1978	No collision between 7 platforms in Federal waters and ships	Santa Barbara Channel

Source: [a]Mc Mullen, J.J. Associates. 1977.
[b]U.S. Coast Guard.
[c]U.S. Geological Survey.

FES Sale No. 35 also summarizes the personal injuries reported under the OCS Lands Act for 1968-1975. A total of 17,343 personal injuries were reported. Since there are insufficient accidental deaths and injuries recorded in the Southern California Bight area, the deaths and injuries record of the Gulf of Mexico were used to estimate the accidents for Sale No. 48 and for combined Sale No. 48 and existing Federal leases.

Table III.A.4.d-1 summarizes the estimates on accidental deaths and injuries as follows: Sale No. 48 2.3 deaths and 943 personal injuries; combined Sale No. 48 and existing Federal leases 6.2 deaths and 2,616 injuries.

Since the accidents from OCS petroleum operations could be independent from shipping traffics, the accidental deaths of 6.2 and injuries of 2,616 could be applied to the cumulative impacts from other projects and proposals listed previously in Chapter I.

Table III.A.4.c-2

COLLISION BETWEEN SHIPS AND PLATFORMS IN GULF OF MEXICO

Date	Number of Collisions Between Ships and Platforms	Ship Size Gross Tons	Location of Collisions	Personal Accidents Injuries	Personal Accidents Deaths	Damage in Dollars Platform	Damage in Dollars Ship
Between July 1962 and June 1973	8	>1,000	3 less than 5 miles from Shipping fairways and anchor areas	0	0	$3.2x10^6$	87,000
"	7	100-650	a	a	0	102,000	426,000
"	15	<100					
Aug. 1975	1	a	Between British Oil Tanker and an unmanned platform under construction caused large oil spill	a	6	a	a

Source: FES Sale No. 43.
[a]Not indicated in the source.

Table III.A.4.c-3

ESTIMATED COLLISION BETWEEN SHIPS AND PLATFORMS FOR SALE NO. 48 AND COMBINED

Items	No. of Platforms	No. of Years	Total No. of Collisions
Gulf of Mexico	1,180	11	30
Sale No. 48	31	14	1.0[a]
Combined Sale No. 48 and existing Federal leases	86	14	2.8[a]

Source: FES Sale No. 48.
[a]Estimates.

Table III.A.4.d-1

ESTIMATED ACCIDENTAL DEATHS AND INJURIES FOR SALE NO. 48 AND COMBINED

Items	No. of Platforms	No. of Years	Estimated Total Deaths	Estimated Total Injuries
Gulf of Mexico	1,330	9	62	2,890/yr[a]
Sale No. 48	31	14	2.3[a]	943[a]
Combined Sale No. 48 existing Federal leases	86	14	6.2[a]	2,616[a]

Source: FES Sale No. 48.
[a]Estimated.

B. Impact of Southern California Conditions on Offshore Oil and Gas Operations

1. Geologic Hazards and Seismic Conditions: Geologic conditions and processes indigenous to the Southern California Outer Continental Shelf must affect, directly or indirectly, petroleum development in ways that could create adverse environmental impact. The conditions and processes of greatest concern are those that could cause a large oil spill and the accompanying conditions that could delay control and cleanup or make them ineffective. The potential for damage from seismic events varies from area to area; thus, it is not possible to describe the myriad of possible geologic hazards and seismic conditions on a regional scale.

The Southern California Borderland (Point Conception to the Mexican Border and extending offshore for about 160 km) is an area of high seismic activity. Although a large earthquake (Magnitude 8) is not known to have occurred in the area, more than 20 earthquakes of magnitude 6.0 or larger have occurred in Southern California since 1912. One of the largest earthquakes on record for this area had a magnitude of 7.5 and was centered west of Point Arguello. The absence of high seismicity in a particular area is not a reliable criterion, by itself, to delineate areas of future seismic activity. For this reason the OCS, where the number of recorded seismic events are less than adjacent mainland areas, should not be considered any less seismicly active than the adjacent mainland area. Tentative findings from the U.S. Geological (Green, Clark, and Field) April 1978 Borderland cruise show that a possibly very large active fault may exist in the OCS off San Diego. This is found in an area where high seismicity would not be expected through review of the seismic event records alone.

Besides the direct hazards of shaking and sea floor offset resulting from an earthquake, many other geologic hazards may be activated as a consequence of a seismic event. In the near and offshore marine environments, liquefaction, slides, slumps, turbidity currents, geologic structural instability, and tsunamis may be triggered by seismic events.

The mapping of faults and areas of unstable seafloor conditions on the ocean floor is accomplished through geophysical profiling surveys, delineation of seismic events, and other geologic analyses. Although main faults and areas of unstable seafloor conditions have been identified in the Southern California Borderland, no detailed records describing the geologic hazards for each of the proposed Sale No. 48 tracts are currently available.

To provide an in depth analyses of geophysical hazards that may exist in the proposed lease sale, the U.S. Geological survey has recently collected geophysical data necessary to identify geologic hazards in each proposed tract. The findings from this study will be made available to the Secretary of the Interior prior to any final tract selection.

If the history of past earthquakes is representative of the average level of seismicity in the Southern California area, a magnitude 6.0 earthquake can be expected in the region about every 10 years; while one could speculate that an earthquake of a magnitude 8 can be statistically expected once every 52 years. Damaging earthquakes have occurred throughout Southern California and can be expected in the future. No particular fault or fault system can be ignored as a potential origin for a local earthquake unless it is demonstratably inactive and not a branch of one of the known or inferred major faults of the region. Movement along a fault plane penetrated by a well hole should be considered as having a potential for causing a major discharge of oil.

Generally, damaging effects of an earthquake can be correlated with proximity to the zone of seismic activity, with the intensity of an earthquake diminishing with distance from the epicenter. The intensity of shaking is, generally, reported as a percent of the acceleration due to gravity. Related shaking (repetitious vertical and horizontal movements associated with a seismic event) imposes extraneous loading (and unloading) upon fixed structures and tends to reduce structural integrity. As an example, compressive waves of earthquakes have been observed to cause elastic compression in petroleum reservoirs resulting in an increase in fluid pressure and the doubling of production over a period of several weeks. Maximum accelerations have been measured for hundreds of strongmotion records, but the sample of actual field records remains small for predicting seismic risk. However, indications, at present, are that the shaking frequencies (about 8 cycles per second) will generate peak accelerations averaging less than 0.4 g (Bolt, 1973). Design criteria require that offshore platforms have sufficient ductility to prevent collapse, yield, or buckling for the maximum level of earthquake activity which may be expected during the life of the structure (API, 1976). Offshore platforms using this criteria for design will minimize impacts.

Mass-wasting (slumping, landslide, liquefaction, etc.) are naturally occurring hazards in the OCS, and are known associative processes affected by earthquake shaking. Mass-wasting involves the "breaking away" and the bulk transfer of masses of debris (rock and sediment) downslope under the direct influence of gravity. There is a continuous series of types which grade from those which are imperceptibly slow to those which are rapid, depending upon degree of slope, thickness, composition, and consolidation of material. Placement of structures on or near unstable, or potentially unstable, areas could result in the rupture of well casing at shallow depths or damage to platforms and seafloor completion structures. If areas of unstable seafloor sediments are avoided, the discharge of oil and gas as a consequence of mass-movement will be minimized.

Tsunamis or seismic sea waves are large oceanic waves that are generated by earthquakes, submarine volcanic eruptions or large submarine landslides. The waves are formed in groups having great wave length and a long period. In deep water, wave heights (crest to trough) may be a few

meters or less, wave lengths of a hundred miles or more and velocities greater than 400 knots (460 mph). As a tsunami enters shallower waters, wave velocity diminishes and height increases. Waves can crest at heights of more than 30 m (100 feet) and strike with devastating force.

If the sea floor is displaced by some mechanism, hydrodynamic factors within the water mass may produce a tsunami. It was found by Iida (1958, 1963) that for a noticeable tsunami to occur, the magnitude (M) of the earthquake must be larger than 6.3 + 0.01 D (D is equal to focal depth in kilometers). If a disastrous tsunami is to occur, the magnitude must be greater than 7.75 + 0.008 D. This shows that an earthquake of at least 6.3 or larger will have to occur, to produce a potentially hazardous tsunami. Iida (1973) also points out that the studies of tsunamis in Japan (1700-1960) reveal that large tsunamis must be generated in deep water. The largest tsunami ever reported in California followed the 1812 earthquake. The wave may have reached land elevations of 15 m (50 feet) at Gaviota and 9.-10.6 (30-35) at Santa Barbara.

Although the potential for a tsunami exists within the Southern California area, the impact from such an event on oil and gas operations is considered insignificant.

Only a few areas within the Southern California Borderland have been investigated specifically for the delineation of potential environmental problems that could be detrimental to OCS petroleum exploration and production. Most of the areas that have been studied in detail have been publicly reported (Vedder et al., 1969; Ziony, et al., 1974; U.S. Geological Survey, 1975; Campbell et al., 1975; Greene, et al., 1975) or are being prepared for publication. In general, the published studies are restricted to the shallow parts of the Santa Barbara Channel, to the Mugu-Santa Monica, San Pedro, and Newport-San Diego shelves, to parts of the Santa-Rosa-Cortes Ridge, and the Tanner and Cortes Banks. The environmental phenomena assessed in these areas include faults, seismicity, sediment instability, sediment erosion, and hydrocarbon seeps.

Santa Barbara Channel. The major faults in the channel region are the Santa Ynez, Red Mountain, Pitas Point, Oak Ridge-McGrath, "Northern and Southern Santa Barbara slope", Santa Cruz Island, and Santa Rosa Island faults. Several of these faults, or associated faults, either are active or potentially active, for they displace Holocene sediment or offset the seafloor (U.S. Geological Survey, 1975, Plate 7).

Many submarine slumps and landslides are present on the seafloor slopes of the Santa Barbara Channel. Most of these features are located along the mainland slope and are especially prominent between Point Conception and Goleta Point and in Hueneme Canyon. In addition, buried disturbed strata observed in seismic profiles at the foot of the Channel Islands platform suggest probable landsliding in the past.

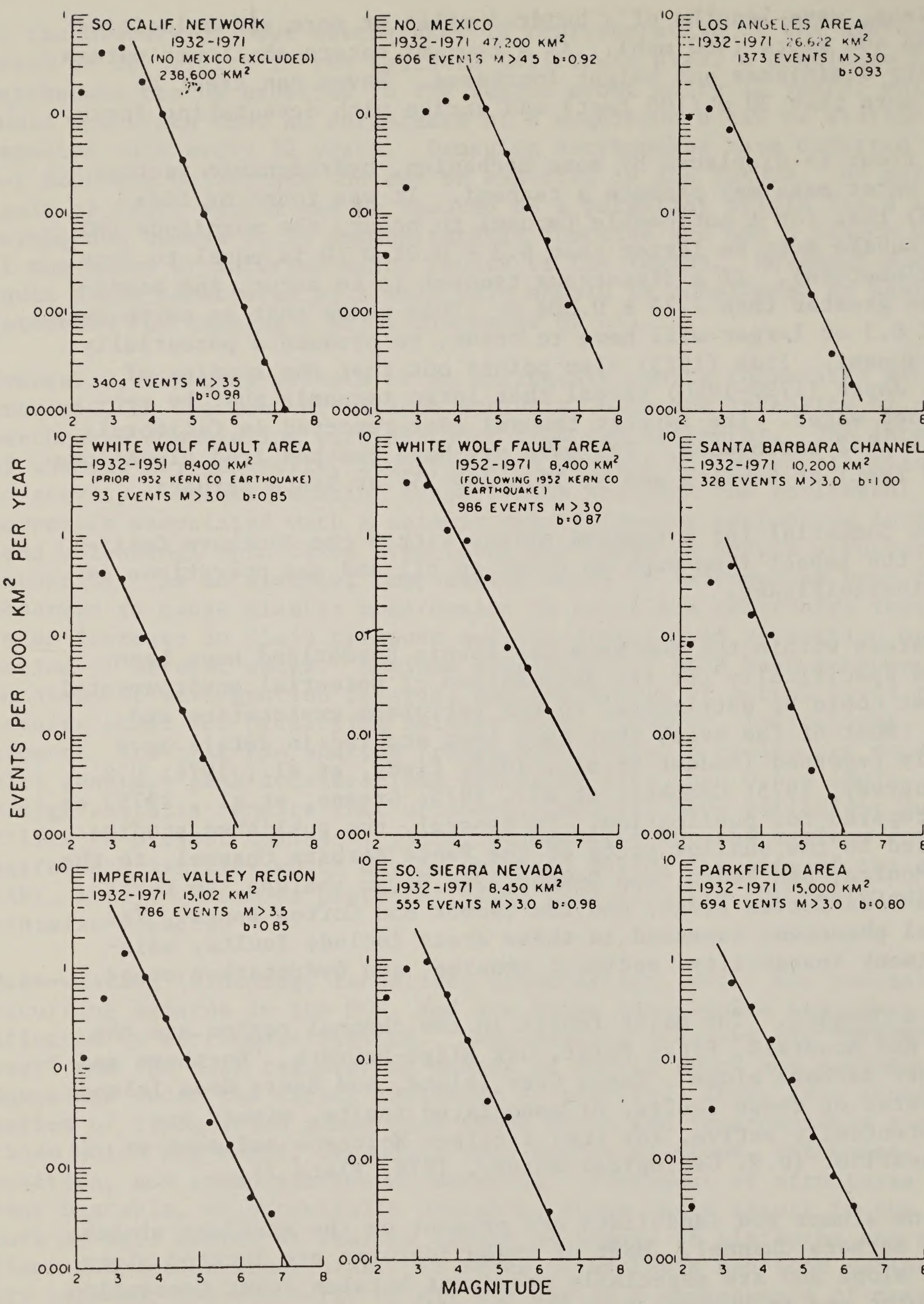


Figure III-B.1-1 Interval recurrence curves for each of the areas shown in Figure III-B.1-2 Note that the ordinate scales are identical for all curves except for the curves for the southern California network and north Mexico areas (Hileman et. al. 1973)

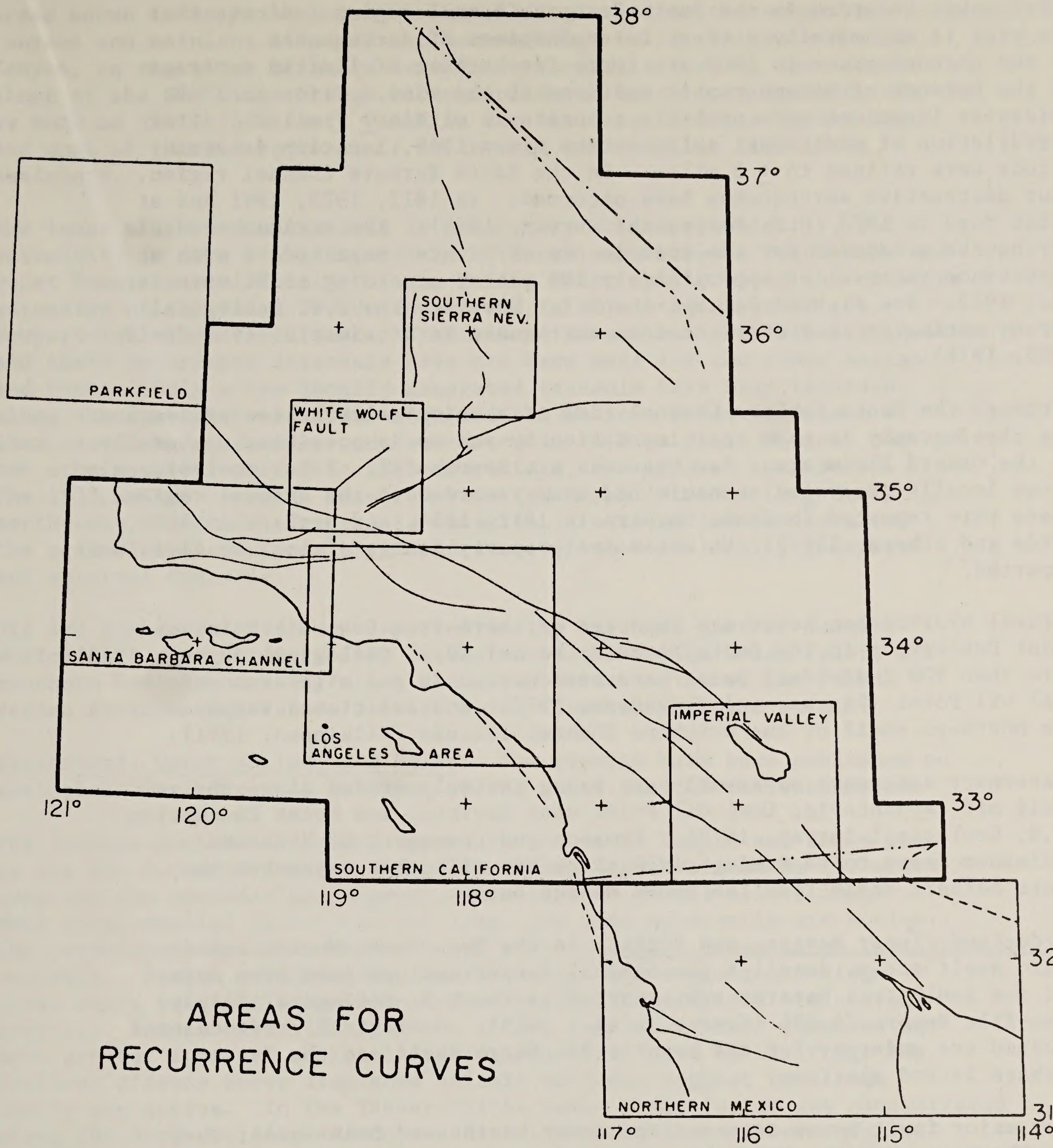


Figure III.-B.1-2 Outlines of the various areas for which recurrence curves are presented in Figure III-B.1-1 Note the heavy outline for the entire southern California area of coverage, excluding northern Mexico (Hileman et al. 1973).

Earthquakes recorded in the Santa Barbara Channel region indicate that the area is seismically active. Determinations of earthquakes in the channel prior to 1969 are imprecise because of limited coverage of the network of seismographic stations at the time. Prior to 1969, epicenter locations were probably accurate to within $\pm$ 7 miles. After installation of additional seismometers since 1969, location determinations were refined to $\pm$ 3 miles. In the Santa Barbara Channel region, four destructive earthquakes have occurred; in 1812, 1925, 1941 and at Point Mugu in 1973 (U.S. Geological Survey, 1975). The maximum credible earthquake predicted for the area is one of Richter magnitude 6 with a recurrence interval of approximately 100 years, according to Hileman, et al., 1973. See Figures III.B.1-1 and 2. However, the U.S. Geological Survey estimates that a 7.5 maximum earthquake is attainable. (FES 76-13 USGS, 1976).

Although the Santa Barbara Channel lies in a seismically active region and the physiography is such that inundation by run-up is possible, especially in the Oxnard Plain area, few tsunamis are documented. Prior to 1967, only three locally generated tsunamis had been recorded in the channel region; these were reported in Santa Barbara in 1812, 1854, and perhaps in 1896 (Iida and others, 1967). No extensive property damage of loss of lives were reported.

Natural hydrocarbon seeps are reported offshore from Coal Oil Point and Point Conception in the Santa Barbara Channel (U.S. Geological Survey, 1975) More than 900 individual seeps have been mapped in a 7 mile area off Coal Oil Point (Fischer and Stevenson, 1973), and additional seeps occur on the northern shelf of the northern Channel Islands (Wilkinson, 1971).

Quaternary sediments apparently are being actively eroded along the mainland shelf off Carpinteria, Coal Oil Point near Gaviota, and Point Conception (U.S. Geological Survey, 1975). Erosion and transport of Holocene sediments seems to be taking place along the sill that separates the Santa Barbara Basin from the Santa Monica Basin.

<u>Borderland, Inner Basins, and Banks</u>. In the Mugu-Santa Monica and San Pedro shelf areas, detailed geophysical investigations have been made, and the geological hazards are reported in the U.S. Geological Survey Open-File Report 75-596 (Greene et al., 1975). Geological environmental studies are underway for the Newport-San Diego shelf and the Santa Barbara Island platform.

Four major fault zones transect the inner basins and banks area; they are the Palos Verdes, Malibu Coast, Newport-Inglewood, and Rose Canyon fault zones. Many faults associated with these zones may be active. Most of the active faults in the Mugu-Santa Monica shelf area are short and discontinuous. Of these, the Malibu Coast fault in the northern part of the area probably is the largest and most likely to generate major earthquakes. In the San Pedro shelf area, active faults seem to be the principal geologic hazard. Probably the most important is the offshore extension of the Palos Verdes fault, which is more than 40 miles long and locally offsets the seafloor. Earthquake epicenters along its trace verify its continuing activity. Many other faults that extend upward to the seafloor must be considered environmentally hazardous, as they cut beds of Holocene age.

Areas known to be prone to submarine sliding occur in the submarine canyons and mainland slope of the Hueneme-Mugu shelf, in Santa Monica Canyon, on the slope offshore from Point Fermin, and along the eastern slope of the San Diego Trough. Unconsolidated Quaternary deposits are as much as 183 m (600 feet) thick in the vicinity of Santa Monica Bay, and most of the San Pedro shelf is covered with similar flat-lying sediments.

The inner basin and banks area is moderately active seismically, and seismicity is most prominent in the offshore area between Point Mugu and Point Dume, in the vicinity of the Malibu Coast fault, along the offshore extension of the Palos Verdes fault, and in adjoining areas of the Newport-Inglewood fault zone. Predictions of maximum credible earthquakes and their recurrence intervals have not been made for the inner basins and banks. Only a few locally generated tsunamis have been recorded along the coast between Point Mugu and the Mexican Border and none of them caused major damage; one was noted in 1879 at Santa Monica, and two others were reported in 1925 (uncertain) and 1933 at Long Beach. The 1933 seismic seawave resulted from the March 10, 1933 Long Beach earthquake. Because the area is seismically active, inundation along the coastal lowlands possibly could result from both locally generated and external tsunamis.

Oil and gas seeps have been reported in the northern part of Santa Monica Bay, along the probable extension of the Malibu Coast fault, in southern Santa Monica Bay along the probable extension of the Palos Verdes fault, and offshore between Point Vicente and Point Fermin.

Borderland, Outer Basins, and Banks. Few reports have been published on geological environmental problems on the outer part of the borderland.

The longest Quaternary fault, mapped in the outer basins and banks area, is the San Clemente fault; the northwestern segment is 80 km (50 miles) long and the southeastern segment, more than 24 km (15 miles) long. Many other smaller faults cut the area, and some apparently are active. The northern Santa Rosa-Cortes Ridge, in particular, seems to be tectonically unstable. Faults are numerous, but are most common along the ridge crest where relatively small apparent vertical separations are characteristic. Beneath the flanks of the ridge, faults are less numerous but have greater apparent vertical separations than those on the ridge top. Seafloor offsets above displaced seismic horizons suggest that some faults are active. In the Tanner-Cortes Banks area, faults are concentrated along the northern flank of Cortes Bank and along the southern edge of the ridges and troughs between the two banks. Many of these faults displace either Holocene sediments or the sea floor.

In the northern Santa Rosa-Cortes Ridge area, many submarine slumps and landslides have occurred along the ridge flanks. Recurrent slumping is likely because slopes are relatively steep, and unconsolidated Holocene sediments are locally thick. Downslope movement by slumping and sediment creep occur along the flanks of Tanner and Cortes Banks. The bank tops, however, are relatively stable and are composed of bedrock with local pockets of unconsolidated Holocene sediments.

Seismicity in the northern Santa Rosa-Cortes Ridge area is moderately active. Most of the earthquake epicenters in this area are randomly scattered, but there is some clustering south of South Point on Santa Rosa Island. Most of the earthquakes in this region have been estimated to be between 2.5 and 4.5 Richter magnitude. During a 4-year period, between 1970 and 1973, the USGS seismic network recorded 11 earthquakes beneath the ridge ranging from less than 2.5 to greater than 3.5 Richter magnitude, Clemente fault. In 1941, a Richter magnitude 5.9 to 6.0 earthquake was recorded from an area near the southeastern extension of the fault. Because Tanner and Cortes Banks lie beyond the limits of the seismographic network, there are no reliable epicenter data and, thus, no estimates of maximum credible earthquakes and recurrence intervals. Green, et al., (1975) reported that the seismicity for the Tanner-Cortes Banks area is scant and inconclusive. Until seismicity data are obtained for this area, a comprehensive assessment of recent fault activity cannot be made. Tsunamis have not been reported in the outer basins and banks region of the borderland. However, the shallow water over most ridges and banks in this region could create potential danger to engineered structures in the event that seismic seawaves traveled through the area.

Although no oil and gas seeps have been reported in the northern Santa Rosa-Cortes Ridge and Tanner-Cortes Banks areas, the combined presence of hydrocarbons in the sediments and a large number of faults suggest that surface seeps and subsurface gas-charged sediments may be present. Proprietary data tend to confirm this possibility.

Distribution of sediment types on the northern part of the Santa Rosa-Cortes Ridge (terrigenous sands on the edges, foraminiferal sands in the center) suggests that bottom currents may be strong on the perimeter and of lesser strength in the center. Both the sparse sediment cover on the ridge top due to the isolation from sediment sources and the abundance of rocky outcrops devoid of sediment suggest the influence of strong current activity. On Tanner and Cortes Banks, strong current activity is suggested by areas of exposed bedrock and by the thinness of the sediment cover over much of the nearby area. The low silt and clay content, relatively good sorting, and coarseness of bank-top sediments also suggest current action, although the coarseness is partly a reflection of the abundant supply of coarse biogenic debris.

Secondary effects, such as seafloor subsidence resulting from fluid withdrawal should be investigated before oil field development.

To summarize the preceeding discussion, one could characterize the Southern California Borderland as a seismically active area with several potential geologic hazards possible in all areas proposed for Sale No. 48.

Geological hazards that may occur within or adjacent to the proposed Sale No. 48 lease tracts could produce the following damage with an oil spill resulting:

(1) Failure of structures and pipelines due to seismic shaking.

(2) Shearing or bending of casing at depth.

(3) Failure of structures and pipelines due to sediment instability resulting from seismic activity.

(4) Destruction of oil tankers, pipelines, and possibly structures as a result of tsunami which is a consequence of ground displacement.

Although we know of no major effects on oil operations attributable to earthquakes, there are accounts of after shocks (4.6 magnitude) from the San Fernando earthquake rupturing several water mains (DES OCS Sale No. 35, written testimony, Whitcomb).

The impacts to geology as a result of extracting oil from geologic formations are limited to ground subsidence and seismicity. Twenty-two oil and gas fields in California are known to have experienced subsidence. The better documented of these fields are located in Los Angeles basin where considerable damage has occurred. The most dramatic example of subsidence damage has taken place in the Wilmington field near Long Beach. Surface displacement within this field caused extensive damage to piplines, oil field equipment, railroad tracks, and buildings.

Although significant subsidence (exceeding 30 cm) is relatively uncommon, surface deformation associated with oil and gas field operations in California has manifested itself in differential subsidence of lands centering on the fields, inwardly dissected horizontal displacements, and faulting.

Subsidence is difficult to predict without information derived from field development activities. Once subsidence is detected, it can be arrested or recovered; thus, mitigating a potential geologic hazard resulting from oil production. The Wilmington oil field is found to have the greatest documented subsidence in the world. The subsidence at Wilmington was halted and has begun to rebound through repressurization in conjunction with the secondary recovery of oil.

The triggering of an earthquake is another potential impact oil production may have on the geology. In studying the effect of oil operations on tectonic activity, Teng, et al., (1972) indicated that oil field operations in Southern California have a negligible effect on seismicity, while Healy, et al., (1972) have shown that fluid repressurization of the subsurface can induce small earthquakes along preexisting fracture zones in a hard rock medium under existing tectonic stress. Allen (DES, OCS Sale No. 35, written testimony) indicates that he would not want to rule out the possibility of some sort of significant oil-production-triggered earthquake, but the historic record both in California and throughout the world suggest that the chances of this happening are exceedingly remote. Since the subject of oil-production-triggered earthquakes is of debate among seismologists, the potential can only be considered a possible pathway from which an oil spill or seep may occur.

2. Meteorology and Physical Oceanographic Conditions: Section II.B and C describe the existing meteorology and physical oceanographic conditions for the Southern California coastal area. The air temperature for the Southern California coast is occasionally above 32.2°C (90°F) during the summer months and is rarely below freezing temperatures south of San Francisco. These temperatures, although low enough to cause discomfort and minor loss of efficiency of personnel involved in offshore operations, are not as severe as those faced in Alaska, the North Sea or Celtic Sea, where successful operations have taken place. Air temperature, therefore, will probably have little impact on offshore operations.

The surface ocean circulation (see Section II.C.2.a) in the major part of the proposed Sale No. 48 area is between 10 to 16 km/day (6 to 9 nautical miles/day). The current (POCS Reference Paper No. II, II.C.1) speeds at the outer bank of the Southern California Bight area is usually less than 22 m/day (12 nautical miles/day) and was reported at speeds of 86 m/day (47 nautical miles/day). Since current speeds up to 17 km/hr (9 knots) are experienced daily for operations in the Cook Inlet, the lower current speed in the Southern California Bight area should not present any operational problems. One possible impact on offshore operations by circulation of water masses would be in the form of scour around the base of jack-up rigs by bottom currents, thereby causing foundation instability.

The most important impact of physical oceanographic conditions on offshore operations would be that of waves. Since the vast majority of sea waves are wind-generated, there is a great deal of overlap in the discussion of oceanographic conditions and meteorological conditions.

Sexton (1976) stated that jack-up rigs can operate with wind speed limitations of approximately 97 km/hr (60 mph), drill ships with wind speeds of 48 km/hr (30 mph) and wave heights of 4 m (13 feet), and semi-submersibles with winds of 80 km/hr (50 mph) and 11 m (36 foot) waves.

A SEDCO semisubmersible on the Canadian shelf off Vancouver Island recorded sustained winds of 121 km/hr (74 mph) with gusts to 161 km/hr (100 mph) accompanied by waves up to 29 m (95 feet) during a severe storm (Sexton, 1976). Hurricanes passing through the Gulf of Mexico, such as Camille, have generated winds of 201 km/hr (125 mph) and 22 m (72 foot) waves (Patterson, 1976).

According to Feder (1975), North Sea wave heights are greater than 2.5 m (8 feet) for 16 to 18 percent of winter. In the Celtic Sea, daily maximum wave heights exceed 3 m (10 feet) 40 percent of the year and 6 m (20 feet) for 5 percent of the year (Oil and Gas Journal, 1975). Data indicate, therefore, that periods when operations will be suspended due to high seas will be less frequent than occur in the North or Celtic Seas.

The California coast (II.C.3 and 4) is not generally subject to severe waves, although damages to shipping and to waterfront areas occurs occasionally. The protection afforded by the offshore islands is generally so complete that significant waves over the shelf are mainly formed in local areas. Waves as high as 7.6 m (25 feet) have been encountered in the San Pedro Channel. Therefore, based on having occasional severe storms, there could be occasional downtime in the oil and gas operation in the Southern California Bight area.

The foggiest months (POCS Reference Paper No. II, II.B.4) for the lower coast of California from Los Angeles southward are those from September to February; and the least foggiest, from May to August. The visibilities are normally less in the eastern portion than in the western portion. The visibilities for the Southern California Bight region during June, July, and August are less than two miles, 2 to 12 percent of the time in the western portion, and 20 to 24 percent of the time in the eastern portion. These low visibility conditions may briefly limit supply of crew activities by helicopter, and slow down boat movement.

In conclusion, the occasional severe storms could cause downtime in offshore oil and gas operation; and the coastal fog could briefly limit the helicopters and boats operation.

C. Impacts of the Proposal Offshore

1. Impact on the Living Component of the Environment - An Introduction

Oil Spills. In order to assess oil spill impacts on the biota of the Southern California Borderland, it is necessary to explore a general overview of the known and disputed facts of the subject. The base of information for this effort must come from studies reported in the literature. Only with this information, can we hope to make judgments of the impacts. As indicated below, the known information on oil spill impacts is incomplete, although the gross overall impacts are known. In those areas where information is incomplete, the weaknesses and scientific disputes should be pointed out. The following introduction presents an overview of: 1) the fate of spilled oil in the ocean, 2) variables and general similarities of oil in the environment, and 3) Santa Barbara blowout overview.

More detailed treatment, including estimation of specific impacts, follows in specific subject sections.

Fate of Spilled Oil in the Ocean. An oil slick floating on the ocean surface will change both in physical configuration and in relative amounts of chemical fractions. The rate of this change depends on environmental factors, inlcuding wind, waves, temperature, suspended sediments and time. The general trend is toward a reduction of the oil mass, especially its lighter fractions. The greater the intensity and quantity of the environmental factors, the greater the amount of oil reduction, and usually dispersion, of the oil slick. Battelle Northwest (1973) outlined the following natural factors which affect the persistence of oil: dilution, evaporation, photo-oxidation, sedimentation by adsorption on suspended particles, and microbial degradation. Certain components of the oil are soluble in water and become separated from the oil slick. The lighter and aromatic fractions of oil tend to be more toxic to organisms, but also become quantitatively reduced relatively early (Evans and Rice, 1974). Anderson, et al., (1973) reported as much as a 90-percent decrease in the total aqueous hydrocarbon concentration fraction in 24 hours with gentle aeration under laboratory conditions. They reported that naphthalenes (diaromatics) are the most toxic and water soluble fractions of oil. The uptake and release described by Anderson and Neff (1974) for naphthalenes is similar to that of the carcinogenic benzo-a-pyrene.

Variables and Similarities of Oil in the Environment. There have been several oil spills where the effect on biological communities has been recorded. Extrapolation of these effects to predict the effects of an oil spill on communities in or near the proposed lease area is difficult because of the many variables involved. What may have occurred during one spill may have little relation with occurrences of another spill at a different geographic location or

time of year. The variables can de divided into the following major categories: 1) the oil itself, 2) fate of the spilled oil, 3) physical and chemical, and 4) biological.

References for the partial list of variables shown on Table III.C.1-1 come from various literature sources (Evans and Rice, 1974; Anderson, et al., 1973; Foster, et al., 1971; Straughan, 1972; Swift, et al., 1970, and Battelle Northwest, 1973), or are common knowledge.

Table III.C.1-1

VARIABLES OF OIL SPILLS AND THEIR EFFECT ON MARINE COMMUNITIES AND ORGANISMS

A) Oil

- Original composition, including:
  - aromatics and diaromatics
  - carcinogenics, etc.
- Age
- Solubility
- Total amount
- Concentration

B) Fate of Spilled Oil

- Dilution
- Evaporation
- Photo-oxidation
- Adsorption on particles and sedimentation
- Microbial degradation
- Solubility
- Treatment of the spill

C) Physical and Chemical

- Amount of fresh water (salinity)
- Suspended sediment (organic and inorganic)
- Temperature
- Tide
- Wave force, period and direction
- Wind velocity and direction
- Current velocity and direction
- geographic location and climate
- Time of year (season)
- Photo-intensity and photo-period
- Substrate-particle size
  - chemical composition
  - stability

Water quality
Shape and size of cove, estuary, harbor or shoreline
Type of beach-rock, sand, slope
Natural or artificial barriers (complete or partial) to oil flow, wave or currents, e. g., flotsam, kelp beds, bulk heads, etc.

D) Biological

Species
Age
Sex
Molting stage
Condition and general health
Time of year, reflecting:
 spawning season
 migration
Previous acclimation
Size
Metabolic rate
Proximity to range periphery
Bacterial inoculum

Despite the multitude of variables and limitations of scientific knowledge on several critical aspects, there are generalizations regarding biotic effects of oil spills which appear to be justified on the basis of the existing literature. These are summarized below by the California State Lands Commission (1974).

> Oil spills may be responsible for lethal effects (e.g., direct chemical toxicity and suffocation), for sublethal effects (e.g., interference with chemically mediated behavior, tainting, carcinogenicity and mechanical coating), and for habitat alteration (e.g., rendering of a substrate unsuitable for settlement of planktonic larvae). Toxicity of oil is closely related to solubility in water, which decreases with molecular weight. Soluble aromatic hydrocarbons and their derivatives are the most toxic components of crude oil. Among the soluble aromatics, napthalenes appear to be highest in toxicity (Anderson, et al., in press). Because of the toxicity and high solubility of low-to-medium molecular weight fractions, these chemicals are potentially the most deleterious components of crude oil in terms of ecological impact. Low molecular weight paraffinic hydrocarbons are less soluble, but may induce narcosis leading to death. Crude oil exposed to environmental weathering forces rapidly loses the low molecular weight components through evaporation and dissolution. Consequently, weathered crude is somewhat less severe in its significance to the ecosystem relative

to fresh crude and refined petrochemicals of the lower boiling ranges. Equivalent volumes of refined petrochemicals (diesel and fuel oils) are much more toxic than crude oils. Residual oils are depleted in lighter (water soluble) fractions and are low in toxicity, but can have important mechanical effects on organisms and their environment. Microbial oxidation operates to reduce straight chain paraffinic components of spilled oil after a period of time, but dissolution of the higher molecular weight aromatics is very slow. Some of the latter may have carcinogenic properties. The environmental impact of spilled crude oil is a function of the amount spilled, the extent to which weathering depletes biologically-active components (especially aromatics), and the physical and biological character of areas affected. It remains to be conclusively demonstrated that marine biotic communities generally lack the capacity to absorb the effects (including substantial mortalities) of acute oil pollution episodes without sustaining significant permanent damage. Possible exceptions are situations where pollution is extremely widespread, or of long duration.

Some of the intermediate stages of petroleum breakdown may be more toxic than the original non-weathered oil.

The lack of knowledge concerning the effects of long-term low-level (chronic) oil pollution on marine organisms should be added to the above generalizations.

The effect of oil spills on biological communities have been studied in other geographical areas, but different environmental conditions render these studies to be poorer predictive tools than the Santa Barbara blowout. The tanker in San Francisco Bay and the TAMPICO MARU spill off Baja California are valuable because they are within the area considered in this statement, but involved more toxic refined oil.

Santa Barbara Overview. During the 1969 Santa Barbara oil blowout, the marine communities within the present lease area were studied, but much of the information coming from the various studies is very conflicting. The reported amount of oil spilled during the peak period varied from 500 barrels/day (McCullogh, 1969) to 5,000 barrels/day (Allen, 1969); the reported time required for the oil to reach the mainland shore varied from one day for "a light film of oil tapered off in a northeasterly direction and intersected the beach west of Carpinteria" (California Department of Fish and Game, 1969), to 3 days (Foster, Charters and Neushul, 1971), to 6 days (Straughan, 1971; Battelle Northwest, 1970).

Estimates of the damage to biological communities also varies. Everyone who considered them, reported that birds were killed in large numbers, but estimates of the damage to the intertidal community varies from essentially none (Anderson, et al., 1969) to 100 percent mortality to barnacles and surf grass leaves at certain locations (Foster, et al., 1971).

The particular set of environmental circumstances at the time of the blowout prevented the potential damage to biological communities from being as extensive as it could have been. 1) The oil did not reach shore, at least in large quantities, for 3 to 6 days after the spill. This allowed most of the more toxic aromatics to volatize and damage to the intertidal community was not as extensive as it could have been (Foster, et al., 1971). 2) According to Battelle Northwest (1970), at approximately the same time the oil finally reached shore, there was some reduction in the amount of oil and gas flow from the blowout, although the flow increased again several days later. 3) The unusually heavy rains of the winter of 1969 brought unusually large amounts of sediment into the area acting as a sinking agent and prevented much of the oil from reaching shore (Kolpack, 1971). 4) The strong winds six days after the blowout scattered the surface oil and may have washed some oil into the sea, thus, reducing contamination of the intertidal zone (Straughan, 1973). 5) The flood also brought flotsam into the area which adsorbed oil (California Department of Fish and Game, 1969). 6) Gains (1970) in Straughan (1972) reported oil was prevented from reaching shore by a natural current barrier, along which oil and other debris collected. 7) Kelp beds withheld oil and prevented massive contamination of the beaches (Battelle Northwest, 1970). 8) The intertidal sandy beach population was at a natural low due to winter erosion of sand away from the beaches (Trask, 1971 and Straughan, 1973). 9) Little detergent was used.

The effects to particular communities are detailed under the appropriate sections, but a general overall summary of the biological effects from the blowout follows: According to Foster, et al., (1971a) and Straughan (1971) biological damage was not widespread. Much of the damage to intertidal areas corresponded to sand movement, probably from storm damage (Foster, et al., 1971b). Cimberg, et al., (1973) concluded that the blowout had less effect on intertidal marine organisms than did sand movement and substrate stability. Seabirds, especially swimming birds, had the highest mortality of any group. The only extensive mortality reported to marine organisms occurred in the upper rocky shore intertidal to acorn barnacles (*Chthamalus fissus*) and eel grasses (*Phyllospadix torreyi*). Breeding rates of barnacles and mussels and larval settlement of barnacles were temporarily inhibited (Straughan, 1971). An unusually heavy winter rainfall at the time

. the spill, which reduced salinities, prevented more definitive statements concerning the effects of oils on the biological communities. It was difficult to separate the effects of thse two factors. Straughan noted factors unique to the Santa Barbara accident: the long history of natural oil seepage in the Santa Barbara Channel, the heavy winter run-off mentioned above, and possibly increased pesticides in the channel.

According to Kanter, et al., (1971) Santa Barbara crude oil is relatively insoluble in seawater and contains a very low percentage of the toxic aromatic compounds. The amount of damage from the toxic fractions of the oil may not have been extensive under any conditions. Damage may be primarily due to smothering.

The time required for a biological community, particularly a benthic community, to recover to its original pre-damage condition is an interesting question. The time required for resettlement of organisms in an area is less than the time required for organisms to reach sexual maturity and begin to reproduce (biological recovery). Still longer is the time required for the community structure to return to that of pre-spill conditions, particularly in "climax" communities involving large organisms which live a long time after reaching sexual maturity. This condition, more than the others, often involves a period where other species are dominant even to the exclusion or near exclusion of the original community dominants.

It is more realistic to consider the establishment of a viable reproducing population as the criterion for normal pre-damage conditions. Because the ocean temperatures of the Southern California Borderland are cooler than those of the Gulf of Mexico, for example, sexual maturity of ecological or phylogeneticly similar species takes significantly longer in California waters (Gunter, 1957). According to Straughan (1971), it requires goose neck barnacles, an important component of intertidal areas, 5 years to reach sexual maturity.

The value of determining the time required for a community to return to its original structure may be important biologically, if, for example, shellfish are more susceptible to predation until their shell reaches a certain thickness after sexual maturity. The greatest problem may involve aesthetic conditions or economic problems in the case of commercially harvested species requiring a certain minimum acceptable size. Other areas, particularly some intertidal areas in Southern California, are already kept to a "sub-climax" stage due to human activity and would not return to the "ideal" climax community structure.

Although this time varies considerably with habitat, some intertidal associations, a mussel bed for example, require approximately 10

years to reach normal population structure when the population is completely destroyed.

For thousands of years the Southern California Borderland has had numerous sites of natural oil seepage. There is evidence that organisms of the area may have even developed some tolerance for oil. Kanter, et al., (1971) found evidence that intertidal mussels (*Mytilus californianus*) from Coal Oil Point were more tolerant to exposure of Santa Barbara crude oil over a 2 month period than *M. californianus* from areas where there was no adjacent oil seepage. This apparent tolerance varies from species to species and is not a general condition for all species (Straughan, personal communication 1975). The composition of seepage oil varies with location even within the Borderland (California State Lands Commission, 1974).

As is evident on Visual No. 9 and Figure III.A.4.a.vii-1, the Santa Barbara Channel area has far more natural oil seeps than other areas in the proposed lease areas. The tolerances developed by inhabitants of Coal Oil Point may not have been developed by organisms in other areas of the proposed lease area. This was, indeed, shown to be true for the common intertidal mussel *Mytilus californianus* (Kanter, et al., 1971).

In preparation of the Georges Bank Petroleum Study, MIT's Offshore Oil Task Group (1973) identified several pathways by which crude oils can exert a damaging effect on plants and animals:

(a) Any disruption at or below cellular level is considered to be a cellular effect,

(b) Any disruption above the cellular level dealing with biochemical processes is considered to be a physiological effect; and

(c) Any disruption of instinctive and/or voluntary control is considered to be a behavioral effect.

They then defined five responses which are elicited by these three types of effects:

(1) Lethal toxicity,

(2) Sublethal disruption of physiological or behavioral activities,

(3) The effects of a direct coating by oil,

(4) Incorporation of hydrocarbons in organisms which cause tainting and/or accumulation of hydrocarbons in food chains; and

(5) Changes in biological habitats.

These responses were taken and applied to three broad categories of spills, and the ecosystems they affect, in Table III.C.1-2.

TABLE III.C.1-2

PATHWAYS AND RESPONSES OF MARINE ORGANISMS IN OIL SPILLS

Source	Lethal Toxicity	Sublethal Effects	Coating With Weathered Oil	Incorporation of Hydrocarbons into Food Webs	Changes in Habitat
Massive Oil Spill	Open Gulf Shoreline Estuary/ Westland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland
Small Oil Spill	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Estuary/ Wetland	Estuary/ Wetland	
Chronic Dis-Charges and Minor Spills	Shoreline Estuary/ Wetland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland

Source: MIT Offshore Oil Task Group (1973).

Explanation of Terms:

Massive Oil Spill: Several hundreds to thousands of barrels.
Small Oil Spill: Fifty to a few hundred barrels.
Chronic Discharges and Minor Spills: Amounts small but very frequent or continuous.
Lethal Toxicity: Interrupts physiological processes at cellular or organ level.
Sublethal Effects: Adverse effects on physiology of growth and reproduction and on instinctive and voluntary behavior.
Coating with Weathered Oil: Large patches of tarry material which has already lost much of its toxicity due to biochemical oxidation, and evaporation.
Changes in Habitat: Lasting for several years, longer than the spill/ cleanup period.
Shoreline: Intertidal to exposed beach; not including estuaries, bordering wetlands.

Pipeline Burial, Drilling Mud, and Cuttings Discharge. Impacts from pipeline burial or placement in shallow waters can occur from pipeline burial by blasting, jetting, and installation of rip-rap (anchoring

unburied pipelines with rock, concrete blocks or concrete bags). Communities which will be affected by these operations are kelp beds and associated communities, other shallow water subtidal regions and beach communities.

It is tentatively assumed that the effects of drilling muds and cuttings discharges are also related to those of dredging, specifically, turbidity and smothering. Of further note, is the presence of barium and chromium in many marine drilling muds, the latter as the organic complex, (ferro) chrome lignosulfonate. Overboard loss or discharge of drilling fluids would introduce some of this barium and chromium into the marine environment.

In general the effects of pipeline burial, drilling mud and cutting discharges are:

(a) Dredging nearshore areas where land pollution has occurred for many years, numerous pollutants will be resuspended in the water column. These may include organic matter which will increase BOD and decrease dissolved oxygen, toxic heavy metals and pesticides which may exert toxic effects before gradually being reincorporated into the sediments.

(b) Dredging in areas of hard bottoms where biotic communities have evolved to take advantage of such conditions and are adapted for attachment to a hard substrate (sponges, soft corals, kelp beds and other seaweeds, sessible molluscs), will eliminate suitable sites for attachment in the path of the operation. These effects will not be permanent and resettlement and reproduction by many of the species will occur before the substrate can become compacted again, a process involving at least several years.

(c) Both pipeline burial and mud/cutting discharges will produce a smothering effect on the burrowing and attached benthos where the material gradually settles as a layer of significant thickness.

(d) Increased turbidity will occur at all marine sites where pipeline burial and mud/cutting discharges take place. The fine particles causing the turbidity can clog the respiratory organs and filter-feeding mechansims of many marine animals.

(e) Pipeline burial in coastal wetlands, uplands and islands would displace many species of wildlife during operations due to noise pollution and the physical presence of construction machinery. This disruption will terminate as soon as construction is completed. The exception may be sea lions and other pinnipeds which possibly will not return to their island breeding sites if human activity occurs too close.

a. Impacts on Plankton

i. Impacts on Phytoplankton

Introduction. This section describes the major impacts on open ocean phytoplankton from the proposed action and the major cumulative impacts from related actions in the study area. Most impacts will take place in the Southern California Bight around the proposed lease areas. According to the most probable development scenarios in Chapter I, the Santa Barbara Channel will have the most resource potential and development activity, followed by the Tanner-Cortes Banks area and the San Pedro Bay area. Outside the Southern California Bight, projected oil spills from the proposed action will impact phytoplankton populations off Baja California and central California. This section considers impacts over the projected life of the proposed development, or about 25 years. Most probable development and impact scenarios to the year 2000 for the proposed action described in Chapters I and III were used to analyze the major impacts. The oil spill model results described in Section III.A and POCS Reference Paper No. VI were also considered.

As discussed in Section II.E.1, the phytoplankton populations off the California and Baja California coasts exist in a nutrient-rich upwelling area with upwelling rates strongest in the spring and early summer months. Consequently, the phytoplankton are most productive and have their largest standing crop in the spring and summer. Standing crop values are lowest in the winter months. The complex circulation patterns in the Southern California Bight produced by the currents, the Southern California Countercurrent and gyre, locally occurring eddies, and shifts in wind and upwelling intensity throughout the year combine to produce a phytoplankton species mixture and patchiness in distribution and abundance that can vary over the whole area throughout the year.

Since the phytoplankton live in the lighted upper 100 to 150 m (330 to 495 feet) of the ocean, this section only considers impacts that will affect this habitat. This analysis is limited by the general lack of detailed information on the phytoplankton for the entire area, the dynamic nature of the marine environment, and the relatively few field and laboratory data for the major phytoplankton impacts discussed as a result of the proposed action.

This impact analysis starts with a brief description of the major impact types from the proposed action, continues with an area-by-area analysis of the major impacts on the phytoplankton for the three OCS development phases, and concludes with a brief summary of the major cumulative impacts for related actions for each area.

Impact Types. As a result of the proposed action, impacts on the phytoplankton will occur from drill cutting and mud discharge from drilling

vessels and platforms; domestic and sanitary waste discharge from drilling vessels and platforms; formation water discharge from producing wells; turbidity effects from sediments disturbed and suspended in the water column by pipeline burial; and chronic and acute oil spills from normal day-to-day operations and accidents such as pipeline ruptures, well blowouts, and tanker collisions or groundings. Toxic and sublethal effects from oil spills could cause the most significant impacts on phytoplankton populations in the ocean surface layer.

Exploration Phase. The major impacts on phytoplankton from exploratory drilling will be from drill cuttings, drilling muds, and sewage waste discharges from exploratory drillships. From historical data, it is assumed that there will not be significant oil spilled during the exploratory phase. This phase is projected to last from 1 to 8 years after the proposed lease sale.

Drill cuttings consist of sand, shale, limestone, and other pieces of the underground strata pulverized by the drilling bit. The drilling muds carry the cuttings back up to the drilling rig where they are separated from the drilling mud, washed to remove oil, and then discharged overboard. The heavy cuttings quickly settle to the bottom and accumulate in a pile beneath the drillship. An estimated 134,590 bbl of drill cuttings could be discharged from 86 exploratory wells in the proposed lease areas over a 1- to 8-year exploration phase. Field studies have demonstrated that drill cuttings do not significantly increase the water column turbidity around the drillship or platform (Ray and Shinn, 1975; Ecomar, 1978). Therefore, it is concluded that drill cuttings discharge will produce an insignificant, local impact on the phytoplankton around the drilling rigs for the 60- to 90-day exploratory drilling period for each well.

Drilling muds consist of clays, barite, lignosulfonates, and small amounts of organic and inorganic chemicals dissolved in water or oil (refer to Section III.A.1.a). Some mud is entrained with the discharged drill cuttings and is continuously lost during drilling. Periodically, some drilling muds will be discharged overboard. An estimated 58,480 bbl of drilling mud will be discharged from 86 exploratory wells in the proposed lease areas over a 1- to 8-year exploration phase. Some portion of the discharged mud settles to the bottom, but the muds usually create a turbidity plume extending down-current from the discharge point under the drilling rig. Ecomar (1978) observed a visible plume extending 2 to 3 km (1.2 to 1.9 miles) from an exploratory well being drilled in 63 m (208 feet) of water on Tanner Bank and discharging at an average rate of 10 bbl/hour. The muds and cuttings discharged were diluted rapidly in the water column, and the investigators found background levels of suspended solids and trace metals within 200 m (660 feet) of the discharge point. They estimated dilution factors of 500:1 to 1,000:1 within 3 m

(9.9 feet) of the discharge pipe at 12 m (39.6 feet) below the water surface with an additional 100:1 dilution factor within 100 m (330 feet).

In the Gulf of Mexico, Zingula (1975) could not detect a mud and cuttings plume greater than 200 m (660 feet) from an Exxon production platform. In another Gulf of Mexico field study, Ray and Shinn (1975) measured background levels of alkalinity, total dissolved solids, total suspended solids, total organic carbon, and total dissolved chromium as close as 27 m (89 feet) to the platform.

The local increased turbidity caused by the plume could decrease phytoplankton photosynthesis by obstructing light penetration in the plume area. This effect would probably last only a few hours for a given water parcel passing by the discharge source. The residence time for phytoplankton within the water parcel and within this reduced euphotic zone would depend on the vertical and horizontal transport at the time. Unlike fish and other good swimmers, the phytoplankton in a given water parcel cannot avoid the turbidity plume, but would pass through it with the water parcel. The decreased photosynthetic effects could cause minor, short-term impacts on the phytoplankton populations that pass through a plume extending 200 m (660 feet) or at a maximum 2 or 3 km (1.2 to 1.9 miles) in the down-current direction from the 86 exploratory drilling wells for this proposed action. This effect would probably have a minor, and probably immeasurable, impact on the total phytoplankton productivity of the Southern California Bight although the chronic long-term effects are unknown at this time.

Drilling mud components can be toxic to marine organisms, and the toxicity varies by the mud type and the organisms tested. McAuliffe and Palmer (1976) summarize the published toxicity data for drilling fluid components. Although there are no data for toxic effects on phytoplankton, the 50-percent lethal concentrations reported for a 96-hour test period for various marine organisms are in the greater than 50 to greater than 100,000 ppm range. Department of Interior (1977) reported bioassay data for drilling muds submitted to EPA Region II for NPDES permits. Bioassays for *Skeletonema costatum*, a common phytoplankton species, showed less sensitivity to salt water gel muds and ferrochrome lignosulfonate freshwater mud than *Acartia tonsa*, a common marine copepod. Fifty percent lethal concentrations were 385 mg/l (ppm) for salt water gel and 230 mg/l (ppm) for ferrochrome lignosulfonate mud for the copepod. Lethal concentrations for drilling mud discharges will probably occur only near the discharge point from the exploratory rigs. With the dilution factors observed in the field and the extent of the plumes around the exploratory rigs, any toxic effects on the phytoplankton would be concentrated locally around the rigs and would have a minor impact on the phytoplankton populations in the Southern California Bight, although the chronic long-term effects are unknown.

Sewage waste discharges from exploratory rigs could also cause minor, local impacts on the phytoplankton passing by the discharge sources.

As described in Section III.A.1.c, sewage discharges are regulated by OCS Orders and Environmental Protection Agency NPDES permits. The discharged sewage contains less than 50 ppm of suspended solids and has a minimum chlorine residual of 1.0 mg/l (ppm) after a minimum 15 minute retention time. Although the effluent will be diluted very rapidly by mixing in the water column, impacts could include local stimulation of productivity around the discharge points and photosynthetic depression by the chlorinated effluent. As discussed in Section II.E.1, Eppley, et al., (1972) reported higher productivity around the Point Loma and Whites Point sewage outfalls than in surrounding areas. Krock and Mason (1972) reported photosynthesis depression for phytoplankton in experiments on chlorinated sewage effluents for San Francisco Bay plankton. These impacts would have a minor, and probably immeasurable, impact on the phytoplankton populations in the Southern California Bight.

Production Phase. The major impacts on the phytoplankton from the production phase will include drill cutting, drilling muds, and sewage waste discharges from production platforms and drillships; formation water discharges from production wells; and chronic and major oil spills from normal day-to-day operations and accidental spills. The production phase is projected to last from 1 to 25 years after the proposed lease sale, extending to 40 years after the proposed sale as fields are developed at different times.

Impacts from drill cuttings, drilling muds, and sewage waste discharges would be similar to those discussed for the exploration phase, except at a greater magnitude over a longer time period. It is estimated that 1,049,920 bbl of drill cuttings, and 451,620 bbl of drilling muds would be discharged from 701 production wells and 71 delineation wells over 21 years. Sewage waste discharges would peak at 54,000 gallons per day for the five proposed lease areas. As discussed previously under the exploration phase, the impacts on the phytoplankton would be local around the platforms. The impacts from these discharge sources on the phytoplankton populations in the Southern California Bight would probably be minor and immeasurable, although the chronic long-term effects are unknown.

Formation waters associated with oil and gas pools contain hydrocarbons, dissolved mineral salts, and traces of heavy metals; are devoid of oxygen; and are denser than the surrounding sea water. Section III.A.1.b discusses the formation water constituents and discharges in detail. Generally, California coastal formation waters have salinities of 22 to 40 parts per thousand. The most common chemical constituents are iron, calcium, magnesium, sodium, bicarbonate, sulphates, and chlorides. These elements and compounds are also commonly found in sea water in different concentrations. Until the year 2000, an estimated 139,568,000 bbl of formation water could be discharged into the marine environment. Table III.A-13 in Section III.A.1.b estimates that 1,241-1,664 metric

tons (9,096-12,197 bbl) of oil and grease could be discharged into the ocean entrained in the formation water over the 16-year period from 1984 to 2000.

Some of the discharged formation water would form a plume extending down-current from the discharge point. Since the formation water is denser than the surrounding ocean water, most of it would sink and mix with deeper waters. Impacts on the phytoplankton could include physiological stress from cells losing water to the surrounding brine, and stress from low dissolved oxygen. Since the dilution rate for the discharged formation water would probably be very high, any harmful effects would be concentrated around the platforms. This increased stress could result in a local depression of phytoplankton photosynthesis close to the discharge point. However, these effects have not been noted in field investigations in the Gulf of Mexico around producing platforms by Mackin (1971) and Gulf Universities Research Consortium (1974). The chronic introduction of low levels of oil and grease into the ocean from formation waters represents an additional chronic source of hydrocarbons that will be discussed below under oil spill impacts. In summary, the impacts of discharged formation water from the production phase probably would not have a significant impact on the phytoplankton populations in the Southern California Bight, although the chronic, long-term effects are unknown at this time.

The major potential impacts on phytoplankton from this proposed action would be from oil spilled into the surface layers of the ocean as a result of normal day-to-day operations and accidental spills. The oil spill model results described in Section III.A and POCS Reference Paper No. VI predict 5 greater than 1,000 bbl oil spills over the production life of the proposed lease area from platform accidents (1.28 spills), pipeline accidents (1.54 spills), and tanker accidents (2.18 spills). Chronic, low-level hydrocarbon sources to the ocean from this proposed action include small spills (less than 1,000 bbl) from accidents and normal day-to-day platform operations, the chronic addition of entrained hydrocarbons from discharged formation water mentioned above, and low-level discharges from tanker landing and off-landing operations. An estimated 11.15 50 to 1,000 bbl spills would occur in the entire proposed lease area over the production life of the fields.

Other sources of hydrocarbons to the ocean in the Southern California Bight include oil and grease discharged from land sewage outfalls (from 6 to 596 bbl/day for each of 6 major outfalls); oil from major natural oil seeps (from 50 to 200 bbl/day for each of two major seep areas); river and stream runoff (from 1 to 27 bbl/day from each of 14 major rivers, creeks and drains); and other low-level hydrocarbon sources from State tidelands production, tankering from existing federal leases, and other projects discussed in the cumulative impact section below.

Impacts on phytoplankton from oil pollution can range from lethal effects under high concentrations in the surface layers of the water column

after a major spill, to sublethal effects such as decreased photosynthesis and growth from low-level concentrations. National Academy of Sciences (1975) states that there is no evidence for food web magnification for petroleum hydrocarbons in the marine environment. NAS (1975) also concludes that phytoplankton can absorb oil on their cell walls, but there is no transfer of hydrocarbons inside the cell at the low levels found in the marine environment.

Hydrocarbons in the marine environment are also derived from biogenic sources, including phytoplankton and other marine plants (Blumer, et al., 1970, 1971; Gelpi, et al., 1968, 1970; Youngblood, et al., 1971). The following discussion summarizes the impacts of oil on phytoplankton from available laboratory and field studies.

Laboratory experiments on the effects of different oil concentrations on species of phytoplankton isolated from different seas have been carried out by Mironov (1975). Using various species of diatoms and dinoflagellates, some of which are quite common off the California coast, Mironov demonstrated that as oil concentrations increase, the reproduction of the phytoplankton decreases relative to the control during 5-day growth periods. He also found that the cells of most species died at a concentration of 1.0 ml/l (1 ppm) during the first day. Mironov also observed a difference in species sensitivity to oil concentrations, and that cells died in a wide range of concentrations from 1.0 to 10^{-4} ml/l (1 to 0.0001 ppm). This indicates a high sensitivity for many phytoplankton species to pollution of sea water by crude oil. Table III.C.1.a-1 summarizes Mironov's results.

Table III.C.1.a-2, taken from National Academy of Sciences (1975), summarizes sublethal effects of oil on phytoplankton from various investigations. NAS (1975) criticizes Mironov's work because he does not mention the type of oil used, and the concentrations reported seem unrealistically low. For sublethal effects from crude oil, it appears from laboratory data that phytoplankton cell division and photosynthesis can be depressed at hydrocarbon concentrations greater than 1 ppm. Lower concentrations in the 10-30 ppb range can stimulate photosynthesis for some species. From the results of these and other laboratory studies, it has been demonstrated that refined petroleum products such as fuel oils have much greater impacts on phytoplankton and marine organisms, in general, than crude oil.

The limited number of field studies conducted after major oil spills examining the impacts on phytoplankton have detected no significant impacts. As discussed in Section III.E.1, since the plankton community's distribution and abundance is so variable and patchy in time and space, it is difficult to notice significant changes greater than the natural variation of the phytoplankton populations. Additionally, the factors influencing the biological effects of an oil spill in the open ocean are

Table III.C.1.a-1

REACTIONS OF ALGAE TO DIFFERENT OIL CONCENTRATIONS IN SEA WATER
(Concentrations in mg/l or ppm)

Algae	Cell Death	Absence or Slowing Down of Cell Divisions	Without Difference from the Control
Gymnodinium foliaceum	1.0-0.1	0.1-0.01	0.001-0.0001
Chaetoceros curvisetus	1.0-0.01	0.01	0.001-0.0001
Gymnodinium wulffi	1.0-0.1	0.01-0.0001	-
Ditylum brightwellii	1.0-0.0001	-	-
Gymnodinium kovalevskii	1.0-0.0001	0.001-0.0001	0.00001
Prorocentrum micans	1.0	0.1-0.00001	-
Peridinium trochoideum	1.0	1.0	0.1-0.00001
Licmophora ehrenbergii	1.0	0.1-0.001	0.0001-0.00001
Platimonas viridis	1.0	0.01-0.001	0.0001
Coscinodiscus granii	1.0	1.0-0.1	0.1-0.0001
Melosira moniliformis	10.0-1.0	10.0-0.1	0.1-0.01

Source: Riznyk (1977).

Table III.C.1.a-2

SUMMARY OF SUBLETHAL EFFECTS ON PHYTOPLANKTON FROM OIL POLLUTION

Group	Species	Reference	Type of Petroleum Product	Concentration	Effects and Evaluation
1. Growth					
Phytoplankton	Several diatoms and dino-flagellates	Mironov, 1970		Concentrations of oil mixed with seawater (1.0-0.001 ml/l); effective concentration *may be* 0.1 ppm-0.1 ppb	No cell division or delayed cell division, compared with controls; dinoflagellates generally more susceptible than diatoms; no mention of type of oil in this work; no measure of concentration of soluble hydrocarbons; concentrations reported seem unrealistically low
	Unspecified microalgae, *Asterionella japonica*	Aubert *et al.*, 1969	Kerosene	3 ppm; 38 ppm	Depression of growth rate; concentration of soluble hydrocarbons unknown
	Phaeodactylum tricornutum	Lacaze, 1967; Nelson-Smith, 1973	Kuwait crude	1% extracts, effective concentration may be 1 ppm	Depression of growth rate; concentration of soluble hydrocarbons unknown
	Chlorella vulgaris	Kauss *et al.*, 1973	Aqueous extracts of several crude oils and outboard motor oil; 90% solutions of aqueous extracts used	1 part oil to 20 parts water	Inhibition of growth varied from 5 to 41% after 2 days of exposure; after 10 days, cell yields were close to controls, suggesting inhibiting substance was eventually lost. After 2 days of cell growth, cell numbers were significantly lower in 25, 50, and 90% oil extracts than in control; concentrations of water-soluble hydrocarbons and comparison of oils unknown
				25-500 ppm solutions of benzene; 25-250 ppm solutions of toluene; 100 ppm solutions of xylene; 3-27 ppm naphthalene	Inhibition of growth of 1-2 days' duration (volatization eventually reduced effect): minimum concentrations tested had an effect but are unrealistically high; lower concentrations should have been tested
	Monochrysis lutheri	Strand *et al.*, 1971	Kuwait crude; dispersant (holl. chem. 622) emulsions	20-100 ppm	Inhibition of growth during 6 days of experiment at all concentrations tested; lowest concentrations had an effect, therefore, lower concentrations should have been studied; effect of crude-dispersant emulsion difficult to relate to other information
	Phaesdactylum tricornutum, Skeletonema costatum, Chlorella sp., *Chlamydomonas* sp.	Nuzzi, 1973	Extracts of outboard motor oil, No. 6 fuel oil, No. 2 fuel oil	1 ppm	Inhibition of growth during 10-12 days incubation with No. 2 fuel oil only at 20% of extracted medium, stimulation of growth by crude and motor oil extracts; concentration of water-soluble hydrocarbons not determined, therefore, it is difficult to compare oils
2. Photosynthesis					
Phytoplankton	Mixed natural samples	Gordon and Prouse, 1973	Venezuelan crude No. 2 and No. 6 fuel oil	10-200 μg/l (ppb)	Concentrations below 10-30 μg/l were found to stimulate photosynthesis, while at concentrations between 60 and 200 μg/l, were somewhat suppressed below controls for all but No. 2 fuel oil which depressed photosynthesis to approximately 60% of controls at concentrations between 100 and 200 μg/l; environment in Bedford Basin: 0.5-60 μg/l; highest content (under slick): 800 μg/l
	Monochrisis lutheri	Strand *et al.*, 1971	Kuwait crude; dispersant (holl. chem. 622) emulsions	1-1,000 ppm	Significant reduction of bicarbonate uptake at concentrations 50 ppm; effect of crude-dispersant emulsion difficult to relate to other information; only observations recorded; no data presented in this preliminary report
	Chlamydomonas angulosa	Kauss *et al.*, 1973	Naphthalene	3-24 ppm	Almost complete reduction of bicarbonate uptake at concentrations as low as 3 ppm in stoppered flasks; when velitization permitted uptake rebounds; lowest concentration tested produced reduction; therefore, experiments at lower, probably more realistic, concentrations should have been conducted

Source: NAS (1975)

varied and complex. NAS (1975) lists the factors as: 1) how much oil is spilled; 2) the oil type; 3) the oceanographic conditions; 4) the meteorological conditions; 5) the turbidity or sediment load in the water column; 6) the season of the year and the corresponding biological cycles; 7) the biological species involved; and 8) the methods of spill cleanup.

Following the TORREY CANYON spill of 860,000 bbl of Kuwait crude oil, Spooner (1969) observed that plankton collections showed damage to minute plant cells from the order Prasinophyceae which float at the water surface. Since a large quantity of toxic detergents were used following the spill, Spooner was uncertain whether the damage was done by oil alone or by a combination of oil and dispersants.

Essentially all the information regarding the effect of oil on phytoplankton productivity in the California coastal zone arose as a result of the 1969 Santa Barbara oil spill (Oguri and Kanter, 1971). This 77,000 bbl crude oil spill took place in January, 1969. Results from a cruise in April, 1969, found unusual low productivity values. During the cruise, 8 of the 9 stations sampled were in the vicinity of the blowout from Platform A, with oil on the surface in sufficient quantity to be easily detected. According to Oguri and Kanter (1971), the possibility that the low productivity resulted from the presence of oil on the water surface does not appear to be borne out by the data. At later dates on cruises during May, 1969, January, 1970, and May, 1970, considerable oil was present on the water surface, yet productivity was not depressed as it was during April, 1969.

To prove their hypothesis that oil had no direct effect on productivity, Oguri and Kanter (1971) during May, 1970, collected an oil sample from the sea surface near Platform A and added it to sets of bottles containing clean water from a station farthest from Platform A. The bottles were routinely tested for productivity. Productivity was not significantly affected by the oil presence during the incubation period. In view of these results, the low productivity values during the cruise of April, 1969, were attributed to the use of dispersants in the vicinity in the months prior to this cruise. The dispersants used were both Polycomplex A-11 (Guardian Chemical Co.) and Corexit 7664 (Enjay Chemical Co.) to mitigate the fire hazard around Platform A and within the harbor (Gaines, 1969).

Straughan (as cited by Dames and Moore, 1975) indicated that plankton after the Santa Barbara spill were probably not affected by the toxic components of the oil at sea since oil on the sea surface is influenced by wind and currents while the plankton are only transported by the currents. Therefore, the plankton and the water would be moving at different rates and the plankton would not be exposed to the oil for a long time period. However, the effects on the surface neuston communities

would be more severe since they would come in direct contact with the oil. Although the neuston was not sampled in the study of the effects of the Santa Barbara spill, Straughan (1971) states "...it is difficult to envision how these organisms could not be affected by oil."

Although the workers who reported on the phytoplankton (Oguri and Kantor) recognize the shortcomings of their methods and the lack of previous adequate background data to compare their results in the report edited by Straughan (1971), Connell (1973), in a critique of the report, states that the shortcomings of the methods did influence the overall assessment of little damage to the marine environment in the Santa Barbara Channel. Connell (1973) concludes that "the plankton...were sampled and reported in such a way as to make it impossible to decide whether there was or was not an effect of oil."

After the collision of the Standard Oil tankers in San Francisco Bay in January, 1971, oil collected from the surface of the Central Bay was used to determine the effect of oil on the photosynthetic rate of plankton taken from oil-free areas. No significant differences were found between responses of plankton from oil-covered and oil-free waters nor as a result of oil additions averaging 3.2 g/l (parts per thousand) (Rinmyk, 1977).

Following the large ARGO MERCHANT spill on the East Coast, Grose and Mattson (1977) reported "no obvious response of phytoplankton to the oil spill." However, the data was not conclusive since it was based on only two non-quantitative samples. The ARGO MERCHANT spill dumped 7,700,000 gallons (183,333 bbl) of No. 6 fuel oil into the North Atlantic. The spill did not reach shore and broke up into large pancakes of oil at sea. The highest petroleum hydrocarbon concentrations measured directly under the oil slick were 250 ppb at 3 m (10 feet) under the slick and 68-435 ppb at the slick surface. The investigators concluded that most of the dissolved hydrocarbons from the spill in the water column were from the "cutter" stock.

The most severe impacts of a major oil spill on the phytoplankton in the study area would be in the spring and summer months when the productivity and standing crop are highest. Lethal effects from a large spill would damage only the phytoplankton in the surface layer of the open ocean. Phytoplankton photosynthesis and cell division could be depressed under a major oil slick if hydrocarbon concentrations in the water column were much higher than 1 ppm. Lower hydrocarbon concentrations would probably stimulate photosynthesis and growth for some species. However, this is a worst-case prediction of impacts that cannot be supported from field investigations.

Michael (1977) concludes that there has been no strong evidence for major damage to plankton communities as a result of an oil spill. The

two factors operating to minimize effects of oil on plankton are: 1) oil fractions that enter the water column disperse rapidly so that concentrations are usually very low; and 2) plankton populations typically have rapid regeneration rates and usually cover large geographic areas. Even if one assumed 100-percent mortality at the site of a spill, it would be difficult to demonstrate the significance of effects on the overall population (Michael, 1977).

Therefore, the projected 1.28 platform spills greater than 1,000 bbl over the production life of the proposed action should not have a significant impact on the phytoplankton populations in the Southern California Bight. The effects might be acute for a short time under a slick in the top-most surface layer of the ocean, but the phytoplankton populations should recover in the area in a few weeks or months.

Chronic oil spill impacts on phytoplankton in the open ocean are unknown. The chronic, long-term input of oil from natural seeps in the area, land runoff, sewage outfall discharge, and tanker spills greatly exceeds the projected hydrocarbon sources from offshore production for this proposed action. SAI (1978) measured concentrations of hydrocarbons in surface and bottom water in the Southern California Bight in 1976, ranging from 0.02 μg/l to 80 μg/l (0.03 ppb to 80 ppb). Figure III.C.1.a-1 gives the reported concentrations. For concentrations in this range, phytoplankton photosynthesis for some species could be enhanced in the low end of the range (10 to 30 μg/l). Photosynthesis could be inhibited for some species at the high end of this range (greater than 60 μg/l). The overall effect could be to reduce species diversity in some highly oiled areas and increase the production of more tolerant, opportunistic species.

<ins>Transportation Phase</ins>. Impacts on the phytoplankton from the transportation phase, in addition to the production phase impacts already discussed, could result from increased oil spills from tanker and pipeline accidents and turbidity effects from burying pipelines.

The oil spill model predicts 1.54 pipeline spills and 2.18 tanker spills for the area compared to 1.28 platform spills for major oil spills greater than 1,000 bbl. Therefore, the impacts of spilled oil on phytoplankton discussed above would be greater in the transportation phase. The areas most heavily impacted from these projected tanker and pipeline spills would be the Santa Barbara Channel area, the Tanner-Cortes Banks area, and the San Pedro Bay area. The oil spill impacts discussed above for the phytoplankton would likewise be most severe in the spring and summer months in the ocean surface layers. The tanker transport scenarios have the potential of increasing the chance of a large spill over a broader geographic area. Phytoplankton populations off central California would be vulnerable to tanker spills from this proposed action.

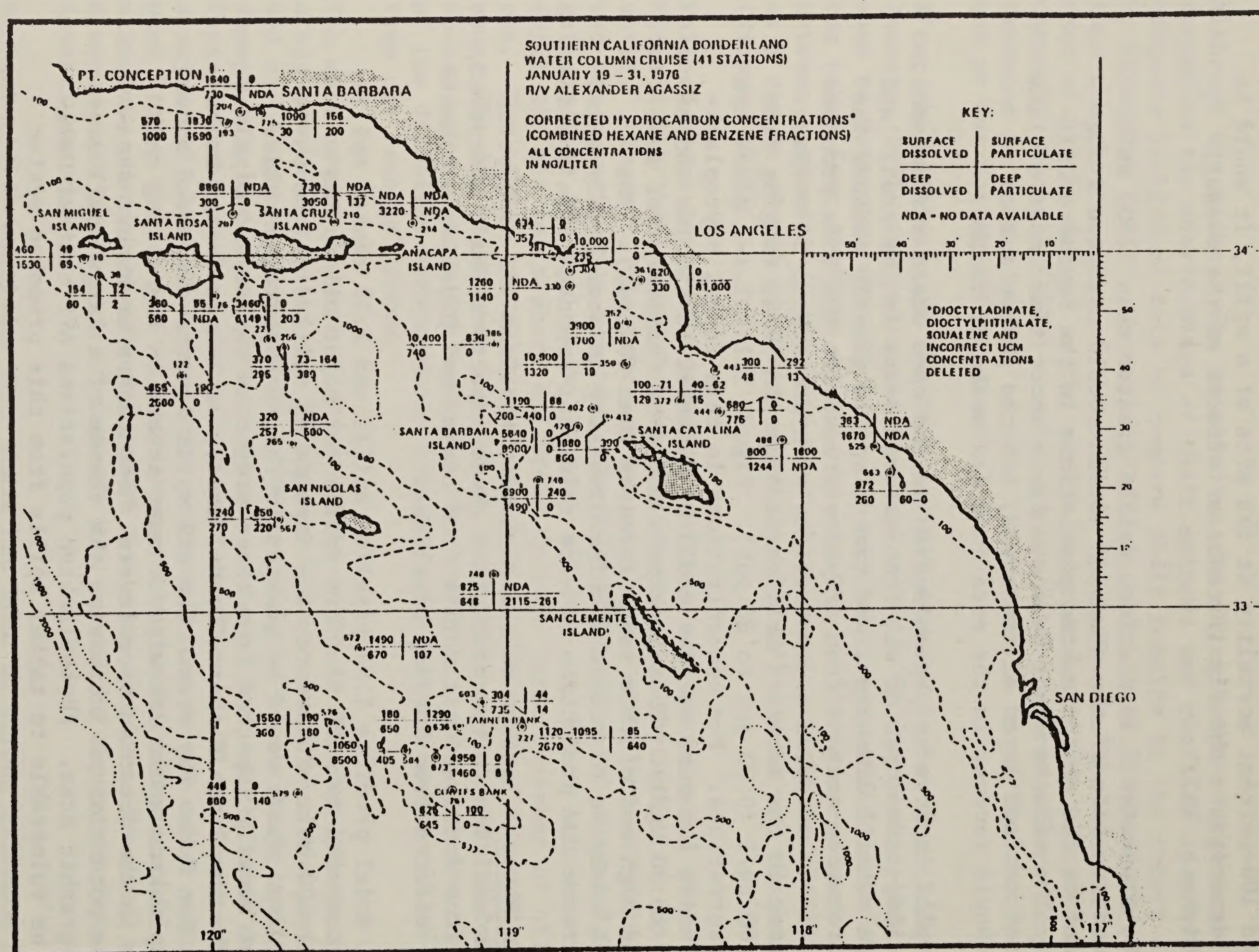


Figure III.C.1.a-1 Station locations and dissolved subsurface (1 to 3-m depth) and near bottom (10 m above the bottom) concentrations of hydrocarbons.

Source: SAI (1978)

Similar to the production phase, the projected tanker and pipeline spills greater than 1,000 bbl probably would not have a significant impact on the phytoplankton populations in the study area. Lethal effects and decreased photosynthesis and cell division in the surface layer under the oil spill might be acute for a short time period, but the phytoplankton populations should recover in the affected area in a few weeks or months. The significance of long-term, chronic effects is unknown, but the effects could be similar to those discussed under the production phase.

Breaks or ruptures of gas pipelines could occur. The probability or frequency of occurrence is unknown. The release of natural gas into the ocean would probably increase the levels of the light molecular weight hydrocarbons (C_2 to C_5). Studies in the Gulf of Mexico near underwater "flares" have shown that high hydrocarbon levels from one source were observed in the surface water over an area greater than 64.8 square km (25 square miles) (Parker, 1974). A study around a platform blowout found that methane, ethane, and propane concentrations decreased by several orders of magnitude within 1.6 km (1 mile) of the seep, but samples taken 16 km (10 miles) from the blowout had concentrations higher than background levels (Brooks and Bernard, 1977). However, there were no observed environmental effects on phytoplankton at these high light-hydrocarbon levels near the blowout (Brooks and Bernard, 1977). Therefore, a gas pipeline break would result in increased levels of light-hydrocarbons near the break, but increased levels would probably return to background levels after the gas flow had been curtailed.

The impacts on the phytoplankton from pipeline burial in shallow water would probably be insignificant. It is estimated that 71.8 km (42.7 miles) of pipeline could be buried along the pipeline routes shown in Section III.A.2. A total of 136,000 m^3 (176,800 yd^3) of sediment could be excavated by jet sled and clamshell dredging. This would occur 4 to 5 years after the proposed sale. The sediment plumes and increased turbidity associated with this activity could produce insignificant, local decreases in phytoplankton photosynthesis in the plumes. The effects could last for a few hours in each water parcel and could extend along a zone about 50 m (165 feet) wide along the pipeline corridor. The total time to bury 71.8 km (42.7 miles) of pipeline would be about 45 days.

Impacts on the Southern California Bight

Santa Barbara Channel. Turbidity and toxic effects from drill cuttings, drilling muds, sewage waste, and formation water discharges and pipeline burial probably would have minor and insignificant impacts on phytoplankton populations in the Santa Barbara Channel as a result of development from this proposed lease sale. Generally, any effects would be maximum during the production phase, with peak production occurring about 8 years after the sale. Muds and cuttings discharge would cease by 10 years

after the proposed sale when all exploratory and development wells are expected to be completed. Formation water discharge would be greater during the last years of production while sewage waste discharges would remain at a fairly constant rate of 20,000 gallons per day, total, for the 10 projected platforms by 8 years after the proposed sale.

Acute and chronic oil spills could have the most impact on the phytoplankton of all impacts considered from this proposed action, as discussed above. The oil spill model predicts 3.1 spills greater than 1,000 bbl and 6.05 spills from 50 to 1,000 bbl to occur in the Channel during development from this proposed sale over the projected 25-year life of the fields. The greatest number of spills would occur during the transportation phase from projected pipeline and tanker spills (Section III.A.4 and POCS Reference Paper No. VI). As discussed above, any lethal effects on phytoplankton would be concentrated in the surface layers. Any effects should be short-term and most significant in the spring and summer months when phytoplankton production and standing crop are highest. Spills reaching the Point Conception area, the northeast part of the Channel, and the waters around the Channel Islands, in the southern part of the Channel, would impact the historically highest areas of phytoplankton production and standing crop for the Channel. From the oil spill trajectory probability tables in POCS Reference Paper No. VI, spills from proposed leases, tanker routes, and pipeline corridors in the Channel would most likely hit the southern part of the Channel around the northern Channel Islands.

With the two large surface current gyres in the Channel, oil spills would probably remain in the open ocean for some time. After 3 days of evaporation and dispersion, most toxic fractions would be greatly diminished. Generally, within 48 hours of a spill, 40 to 60 percent of the spill should evaporate (Slack, Wyant, and Lanfear, 1978). Within 10 days, most of the spill could be cleaned up or contained if conditions are favorable. If non-toxic dispersants are used, the oil could be kept in the upper 3 to 4 m (9.9 to 13.2 feet) of the water column for a longer time period. The impacts on the phytoplankton from oil-dispersant mixtures are unknown, but are assumed to be no greater than the oil effects alone since EPA now approves all dispersants to be used.

As discussed previously, the chronic, long-term impacts on the phytoplankton from major and minor oil spills over the projected 25-year production life from this proposed sale are unknown. Studies in the Gulf of Mexico have found no significant or measurable impacts on phytoplankton productivity or standing stock from offshore oil production in the area (Gulf Universities Research Consortium, 1974).

San Pedro Bay. This area has the third highest projected resource value for this proposed sale. Oil production could peak at 7 years after the proposed sale, or in 1986. The impacts on the phytoplankton from

discharges and pipeline burial would be similar to the Santa Barbara Channel, except at a lower magnitude. Muds and cuttings discharge would cease by 11 years after the proposed sale, and formation water discharge would be greatest during the last years of production. Sewage waste discharge would remain at a fairly constant 6,000 gallons per day rate for the 3 projected offshore platforms.

The oil spill model predicts only 0.47 spills greater than 1,000 bbl and 1.38 spills from 50 to 1,000 bbl to occur in the San Pedro Bay area during development from this proposed sale over the projected 25-year life of the fields. The impacts on the phytoplankton populations in the area would be similar to those discussed for the Santa Barbara Channel, except at a lower level since the predicted number of spills is very low. Any effects would be most significant in the spring and summer when phytoplankton productivity and standing crop is greatest. In the spring, a spill could impact the dense populations of dinoflagellates that usually occur in a band out to 40 km (24.8 miles) from the coast. However, since the maximum concentrations for these blooms are generally at 15 to 20 m (49.5 to 66 feet) deep (Section II.E.1), any short-term, lethal effects at the water surface should not reach the major population concentrations. Spills in the spring and summer could impact the dense red tide blooms of *Gonyaulax polyedra* that occur nearshore. A synergistic effect of a large oil spill and a red tide bloom could reduce the oxygen in the surface layer of the water column and contribute to normally occurring fish and invertebrate kills in restricted circulation areas. However, the probability of this occurring is low, due to the low number of spills projected for this area.

Dana Point-San Diego. This area has the fourth highest projected resource value for this proposed sale. Oil production could peak at 7 years after the proposed sale, or in 1986. The impacts on the phytoplankton from platform and drilling rig discharges would probably be insignificant. Muds and cuttings discharge would stop by 1988, and formation water discharge would be greatest during the last years of production. Sewage waste discharge would remain at a fairly constant 6,000 gallons per day rate after 1986 for the 3 projected offshore platforms for the entire area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.17) and an insignificant number of 50 to 1,000 bbl spills (0.29) to occur in the area over the projected 25-year life of the fields. Any oil spill impacts on the phytoplankton would be similar to those discussed for the San Pedro Bay area, except at a lower magnitude. From limited data, the phytoplankton standing crop in this area is generally highest in spring and summer.

Santa Rosa Area. This area has the fifth highest projected resource value for this proposed sale. Oil production could peak at 7 years after

the proposed sale, or in 1986. The discharges from the projected 1 production platform and the exploratory activity for 3 exploratory wells would probably have an insignificant impact on the phytoplankton populations in the area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.17) over the projected 25-year life of the field. Therefore, impacts on phytoplankton in this area from oil spills would be low.

Tanner-Cortes Area. This area has the second highest projected resource value for this proposed sale. Oil production could peak in 1986. The impacts on the phytoplankton from discharges and pipeline burial would be similar to those discussed for the Santa Barbara Channel. Muds and cuttings discharge would stop by 1990, and formation water discharge would peak during the last years of production. Sewage waste discharge would remain at a fairly constant 18,000 gallons per day rate after 1986 for the 9 projected offshore platforms.

The oil spill model predicts 1.14 spills greater than 1,000 bbl and 3.17 spills from 50 to 1,000 bbl from this proposed sale over the projected 25-year field life. Short-term, lethal effects on phytoplankton in the surface layers could be most significant in the spring and summer months when production and standing crop are high. Since the predominant wind direction and surface current flow in the area is to the southeast, most spills occurring in the area would be carried south and southeast. Impacts from acute and chronic spills would be similar to those discussed for the Santa Barbara Channel.

Santa Barbara Island Area. This area has the lowest projected resource value for the proposed sale. Production would peak in 1986. Discharges from the projected 1 platform and the exploratory activity for 2 exploratory wells should have an insignificant impact on the phytoplankton populations in the area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.09) over the projected 25-year life of the field. Therefore, impacts on phytoplankton in this area from oil spills from the proposed action should be low.

Baja California Impacts. The only impacts on phytoplankton populations off Baja California from this proposed sale would be from oil spills from proposed lease areas drifting south with the southeasterly-flowing California Current. Any spills reaching the waters off Baja would be greatly weathered, with most toxic fractions dissolved. The greatest number of potential spills from the southernmost lease areas are 1.14 predicted from the Tanner-Cortes area and 0.17 predicted from the Dana

Point-San Diego area. The oil spill model predicts very low (less than 5 or 10%) or negligible hits on land segments or resources in the Baja area from oil spills in the Southern California Bight. Therefore, the impact on phytoplankton populations off Baja should be low to insignificant. Any impact would be greatest during the spring and summer months when the upwelling is strongest and phytoplankton productivity and standing crop is greatest.

Central California Impacts. The only impacts on phytoplankton populations off central California from this proposed sale would be from oil spills from tankering production from the Santa Barbara Channel, Santa Rosa, and Tanner-Cortes Banks areas. The oil spill model predicts only 0.65 spills greater than 1,000 bbl for the Ventura to San Francisco tankering leg. The transportation phase would start in 1982, or 3 years after the proposed sale. Production for the proposed sale area would peak about 7 years after the proposed sale, or in 1986. The probability tables in POCS Reference Paper No. VI for central California predict probabilities of less than 6 percent for spills reaching central California land segments or resources from this proposed sale. Any spill along tankering legs T9, T10 and T11, shown in Figure 1-A of POCS Reference Paper No. VI, has the greatest probability for impacting coastal phytoplankton populations.

If a spill should occur along the tankering leg, it would have the most impact on phytoplankton populations during the spring and summer. Since the predicted number of oil spills from this proposed sale is very low for this tankering leg, any impact on phytoplankton populations would be low.

Cumulative Impacts

Southern California Bight. The related projects considered for cumulative impacts in the area, along with the proposed action, are described in Section I.C.5. The greatest additional OCS oil and gas activity from existing and proposed federal and State development would be in the Santa Barbara Channel, followed by the San Pedro Bay and the Tanner-Cortes Banks areas. The Santa Rosa area and Santa Barbara Island area would have associated OCS development from Federal Sale No. 35 leases, while the Dana Point-San Diego area would have no additional existing or projected OCS development except from this proposed sale. Increased tanker traffic in the Santa Barbara Channel and San Pedro Bay area would result from existing imports of foreign crude, additional tankering of Alaskan crude through the Santa Barbara Channel to Long Beach, tankering of Elk Hills oil production from Port Hueneme to Long Beach and San Francisco through the Santa Barbara Channel, and LNG tankering either in the Santa Barbara Channel or in the San Pedro area.

Additional cumulative impacts on the phytoplankton populations in the Bight from drill cuttings, drilling muds, sewage waste, and formation water discharges and sedimentation effects from pipeline burial would probably be low. although the chronic long-term effects are unknown. Any effects would be similar to those discussed previously.

The additional, cumulative impacts on the phytoplankton from acute and chronic oil spills would probably produce the greatest effects. The oil spill model predicts a total of 19 oil spills greater than 1,000 bbl and 42.76 spills from 50 to 1,000 bbl from proposed Sale No. 48, existing federal leases, and tankering of Alaskan and foreign crude into the area. This does not include spills from existing and projected State tidelands development within 4.8 km (3 miles) of the coast. The model predicts a total of 5 greater-than-1,000 bbl spills from proposed Sale No. 48 development, 9.3 spills from existing federal OCS leases, and 4.7 spills from Alaskan and foreign tankering. Oil spills from 50 to 1,000 bbl size are predicted as 11.15 spills for proposed Sale No. 48 development and 31.61 from existing federal leases and tankering of Alaskan and foreign crude. These projections assume a pipeline-tanker transportation mix for offshore production from proposed Sale No. 48 and existing federal leases. If 100 percent of the oil production were tankered from proposed and existing federal leases, the model predicts 11.6 greater than 1,000 bbl spills for the Bight, versus 14.3 greater than 1,000 bbl spills from a mix of pipeline and tanker transportation.

As mentioned previously, the greatest potential for additional oil spill impacts on the phytoplankton would be in the Santa Barbara Channel area (9.63 greater than 1,000 bbl spills and 18.78 50 to 1,000 bbl spills), followed by the San Pedro Bay (4.96 greater than 1,000 bbl spills and 14.56 to 1,000 bbl spills) and the Tanner-Cortes Banks area (3.67 greater than 1,000 bbl spills and 8.14 50 to 1,000 bbl spills). The cumulative oil spill impacts on the phytoplankton in the Santa Rosa, Santa Barbara Island and Dana Point-San Diego areas would be low. All of these predicted spills are totals projected over the expected 25-year life of the fields.

The cumulative impacts on the phytoplankton from the predicted major and minor spills in the Santa Barbara Channel, San Pedro Bay, and Tanner-Cortes areas are unknown. As discussed previously, oil spill impacts from acute spills could have some lethal and sublethal effects on phytoplankton in the near-surface layer of the water column. These impacts would be short-term and the phytoplankton should recover from any effects within a few weeks to a few months. Plankton populations, in general, have relatively short life cycles and rapid reproductive rates. Also, since they extend over the entire area and are moving constantly with the currents, it would not be possible to destroy a significant portion of the population, even with a major spill.

The chronic, long-term effects of additional oil spills from the proposed and related actions are unknown. Investigations by the Gulf Research Consortium (1974) in the Gulf of Mexico reported no significant effects on phytoplankton productivity and standing crop in an area heavily developed by OCS oil and gas activity over many years. Overall, the long-term, chronic additions of hydrocarbons to the marine environment in the Bight from the proposed and related actions must be put in perspective to the large daily oil seepage from natural seeps over thousands of years (40 to 670 bbl/day estimated for the Santa Barbara Channel, alone), the large daily oil and grease discharges from land sewer outfalls (6 to 596 bbl/day estimated for each of 6 major outfalls), and oil runoff from rivers, creeks and drains from land (1 to 27 bbl/day from 14 major sources).

Baja California. The only additional, cumulative impacts on phytoplankton populations off Baja California would result from additional oil spills reaching the area. Any spills reaching the waters off Baja from the Southern California Bight should generally remain offshore and be in a dispersed, weathered state. The impacts on the phytoplankton should be low.

Central California. Once again, increased oil spill impacts from tankering would be the only major impacts on phytoplankton populations. The increased tankering for Alaskan crude and cumulative oil production from the Santa Barbara Channel and Tanner-Cortes Banks areas will increase the probability of spills along tanker legs T9 through T12 and T1 through T4 (see Figure 1-A in POCS Reference Paper No. VI). Impacts on the phytoplankton from acute spills should be short-term and low. Long-term, chronic impacts on phytoplankton from spills associated with increased tanker traffic along the coast are unknown.

In summary, the impacts from this proposed sale on the phytoplankton populations in the study area would probably not be significant in the short-term. As previously stated, chronic long-term effects are unknown. Major adverse impacts could include local reduction in phytoplankton productivity around drilling platforms and rigs from discharges into the ocean; short-term decreases in phytoplankton productivity and standing crop in the near surface layer of the ocean under a major oil spill; and unknown long-term effects from chronic oil spills and other discharges over the development life of the fields, or from 25 to 40 years after the sale date. The greatest impacts would occur in the Southern California Bight in the proposed lease areas with development activities in the Santa Barbara Channel area producing the most impacts since the Channel has the highest projected resource potential and the greatest number of predicted oil spills from this proposed sale. Impacts on phytoplankton populations off Baja and central California would probably be low to insignificant.

Seasonally, the greatest impacts from oil spills on phytoplankton in the ocean surface layer would be in the spring and summer months when productivity and standing crop are greatest. Over time, most impacts would be concentrated in the production and transportation stages. Impacts from areas already leased and from other related projects would be greater than impacts on the phytoplankton from this proposed sale. Because of the natural variability of phytoplankton productivity and abundance in the dynamic ocean surface layer, major adverse impacts would probably not be measureable in the open ocean environment.

ii. Impacts on Zooplankton

Introduction. This section describes the major impacts on open ocean zooplankton from the proposed action and the major cumulative impacts from related actions in the study area. Most impacts on zooplankton will take place in the Southern California Bight around the proposed lease areas. According to the most probable development scenarios in Section I, the Santa Barbara Channel will have the highest resource potential and development activity, followed by the Tanner-Cortes Bank area and the San Pedro Bay area. Outside the Southern California Bight, projected oil spills from the proposed action will impact zooplankton populations off Baja California and Central California. This section considers impacts over the projected life of the proposed development, or about 25 years. Most probable development and impact scenarios to the year 2000 for the proposed action described in Section I and III.A were used to analyze the major impacts. The oil spill model results described in Section III.A and POCS Reference Paper No. VI were also considered.

As discussed in Section II.E.1, the zooplankton populations off the California and Baja California coasts exist in nutrient-rich upwelling areas with upwelling rates strongest in the spring and early summer months. Zooplankton concentrations are highest in the spring and summer with peak biomass usually occurring during the summer, lagging a few months behind peak phytoplankton abundance. Like the phytoplankton, zooplankton standing crop values are lowest in the winter. Generally, the most dense zooplankton concentrations in the Southern California Bight are 80 to 100 km offshore, with high concentrations around Point Conception and the Santa Rosa-Cortes Ridge. Off the Central California coast, zooplankton concentrations are high off the San Francisco Bay throughout the year, while off Baja California consistently high zooplankton concentrations are found off Punta Eugenia.

The complex circulation patterns in the Southern California Bight produced by the currents, the Southern California Countercurrent and gyre and locally occurring eddies throughout the year combine to produce a zooplankton species mixture and a patchiness in distribution and abundance that can vary over the whole area throughout the year. Several zooplankton species migrate vertically to the surface layer of the water column at

night to feed, and this adds to the complexity and variability of zooplankton patterns in surface waters at any given time. Generally, the younger stages of zooplankton and fish larvae are found in the surface layer (see Section II.E.2).

This section will primarily consider the impacts on zooplankton in the upper layer of the water column sampled by the CalCOFI program, or the upper 140 m. Although general distribution patterns are well known, this impact analyses is limited by the lack of detailed information for the zooplankton for a given area over a short time period, the dynamic nature of the marine environment, and the overall scarcity of field and laboratory data for the major zooplankton impacts discussed as a result of the proposed action.

The impact analysis starts with a brief description of the major impact types from the proposed action, continues with an area-by-area analysis of the major impacts from the proposed action on the zooplankton for the three OCS development phases, and concludes with a brief summary of the major cumulative impacts for related actions for each area.

Impact Types. As a result of the proposed action, impacts on the zooplankton will occur from drill cuttings and drilling mud discharged from drilling vessels and platforms; domestic and sanitary waste discharge from drilling vessels and platforms; formation water discharges from producing wells; turbidity effects from sediments disturbed and suspended in the water column by pipeline burial; and chronic and acute oil spills from normal day-to-day operations and accidents such as pipeline ruptures, well blowouts and tanker collision or groundings. Toxic and sublethal effects from oil spills would probably cause the most significant impact on zooplankton populations in the ocean surface layer.

Exploration Phase. The major impacts on zooplankton for exploratory drilling will be from drill cuttings, drilling muds and sewage waste discharges from exploratory drillships. From historical data it is assumed that there will not be significant oil spills during the exploratory phase. This phase is projected to last from 1 to 8 years after the proposed lease sale.

Drill cuttings consist of sand, shale, limestone and other pieces of the underground strata pulverized by the drilling bit. The drilling muds carry the cuttings back up to the drilling rig where they are separated from the drilling mud, washed to remove excess oil, and then discharged overboard. The heavy cuttings settle quickly to the bottom and accumulate in a pile beneath the drillrig. An estimated 134,590 barrels (bbl) of drill cuttings will be discharged from 86 exploratory wells in the proposed lease areas over a 1 to 8 year exploration phase. Field studies have demonstrated that drill cuttings do not significantly increase the water column turbidity around drill ships or platforms (Ray and Shinn,

1975; Ecomar, 1978). Therefore, it is concluded that drill cutting discharges would produce an insignificant, local impact on the zooplankton around the drilling rigs for the 60 to 70-day exploratory drilling for each well.

Drilling muds consist of clays, barite, lignosulfonates and small amounts of organic and inorganic chemicals dissolved in water or oil (refer to Section III.A.1.a). Some mud is entrained with the discharged drill cuttings and is continuously lost during drilling. Periodically, some drilling muds will be discharged overboard. An estimated 58,480 bbl of drilling mud will be discharged from 86 exploratory wells in the proposed lease area over a 1 to 8-year exploration phase. Some portions of the discharged mud settles to the bottom, but the muds usually create a turbidity plume extending down-current from the discharge point under the drilling rig. Ecomar (1978) observed a visible plume extending 2 to 3 km (1.2 to 1.9 miles) from an exploratory well being drilled in 63 m (208 ft) of water on Tanner-Cortes Bank, and discharging at an average rate of 10 bbl/hour. The mud and cuttings discharged were diluted rapidly in the water column and the investigators found background levels of suspended silts and trace metals within 200 m (660 ft) of the discharge point. They estimated dilution factors of 500:1 to 1000:1 within 3 m (9.9 ft) of the discharge pipes at 12 m (39.6 ft) below the water surface with an additional 100:1 dilution factor within 100 m (330 ft). In the Gulf of Mexico, Zingula (1975) could not detect a mud and cutting plume greater than 200 m (660 ft) from an Exxon production platform. In another Gulf of Mexico field study, Ray and Shinn (1975) measured background levels of alkalinity, total dissolved solids, total suspended solids, total organic carbon and total dissolved chromium as close as 27 m (89.1 ft) to the platform.

The local increased turbidity caused by the plume could have a smothering effect on some zooplankton species in the surface layer of the water column in the plume area. The increased turbidity could result in temporary clogging of the filter feeding mechanisms of some zooplankton, resulting in decreased filtering and feeding efficiency. However, this effect would probably last only a few hours for a given water parcel passing by the discharge source. The residence time for zooplankton within the water parcel would depend on the vertical and horizontal transport at the time. Unlike fish and other good swimmers, the zooplankton in a given water parcel cannot avoid the turbidity plumes, but will pass through them with the water parcel. The smothering effect from turbidity would cause minor, short-term impacts on the zooplankton populations that pass through a plume between 200 m (660 ft) and a maximum of 2 or 3 km (1.2 to 1.9 miles) in the down-current direction from the 86 exploratory drilling wells for this proposed action. This effect would probably have a minor, and probably immeasurable, impact on the zooplankton population of the Southern California Bight.

Drilling mud components can be toxic to marine organisms and the toxicity varies by the mud type and the organisms tested. McAuliffe and Palmer (1976) summarize the published toxicity data for drilling fluid components. The 50 percent lethal concentrations reported for a 96-hour test period for various marine organisms are in the greater than 50 to the 100,000 ppm range. Department of the Interior (1977) reported bioassay data for drilling muds submitted to EPA, Region II, for 50 percent lethal concentrations as 385 mg/l (ppm) for salt water gel and 230 mg/l (ppm) for ferrochrome lignosulfonate mud for the copepod *Arcartia tonsa*. Lethal concentrations for drilling mud discharges would probably occur only near the discharge point from the exploratory rigs. With the dilution factor observed in the field and the extent of the plume around the exploratory rig, any toxic effect on the zooplankton would be concentrated locally around the rig, and would probably have a minor impact on the zooplankton populations in the Southern California Bight.

Sewage waste discharges from exploratory rigs would also cause minor, local impacts on zooplankton passing by the discharge sources. As described in Section III.A.1.c, sewage discharges are regulated by OCS Orders and Environmental Protection Agency NPDES permits. The discharged sewage contains less than 50 ppm of suspended solids, and has a minimum chlorine residual of 1.0 mg/l (ppm) after a minimum 15 minute retention time. Since the effluent would be diluted very rapidly by mixing in the water column, any effects would have a minor and probably immeasurable impact on the zooplankton populations in the Southern California Bight.

Production Phase. The major impacts on the zooplankton from the production phase will include drill cuttings, drilling mud and sewage waste discharges from production platforms and drilling; formation water discharges from production wells; and chronic and major oil spills from normal day-to-day operations and accidental spills. The production phase is projected to last from 1 to 25 years after the projected lease sale, extending into 40 years after the proposed sale as fields are developed at different times.

Impacts from drill cuttings, drill muds and sewage waste discharges would be similar to those discussed for the exploration phase, except at a greater magnitude over a longer time period. It is estimated that 1,049,920 bbl of drill cuttings and 451,620 bbl of drilling muds will be discharged from 701 production wells, and 71 delineation wells over 21 years. Sewage waste discharges will be 2,000 gallons per day for each platform and drillship. As described previously under the exploration phase, the impacts on zooplankton would be local around the platforms. The impacts from these discharge sources on the zooplankton population in the Southern California Bight would be minor, and probably immeasurable in the long term.

Formation waters associated with oil and gas pools contain hydrocarbons, dissolved mineral salts and traces of heavy metals; are devoid of oxygen; and are denser than the surrounding sea water. Section III.A.1.b discusses the formation water constituents and discharges in detail. Generally, California coastal formation waters have salinities of 22 to 40 parts per thousand. The most common chemical constituents are iron, calcium, magnesium, sodium, bicarbonate, sulphates and chlorides. These elements and compounds are also commonly found in sea water in different concentrations. Over the production life of the proposed lease area an estimated 139,568,000 bbl of formation water will be discharged into the marine environment. Table III.A-10 in Section III.A.1.b estimates that 1,241-1,664 metric tons (9,096-12,197 bbl) of oil and grease will be discharged into the ocean entrained in the formation water over the 16-year production life of the proposed lease area.

Impacts on the zooplankton from discharged formation water could include physiological stress from dissolved salts and stress from low-dissolved oxygen. Since the dilution rate for discharged formation water would probably be very high, any harmful effects would be concentrated around the platforms. The chronic introduction of low levels of oil and grease entering the ocean from formation water represents an additional chronic source of hydrocarbon that will be discussed below under oil spill impacts.

Field investigations in the Gulf of Mexico conducted around producing platforms by Mackin (1971) and Gulf Universities Research Consortium (1974) found no detectable effects on zooplankton populations from platform discharges. Preliminary results reported by National Marine Fisheries Service (1977) for a study of offshore oil impacts in the Buccaneer oil field and a control area 51.5 km (32 miles) offshore of Galveston, Texas in the northwestern Gulf of Mexico suggest that discharged formation water is a major pollution source in the oil field. For surface zooplankton samples the investigators found some elevated hydrocarbon concentrations, but the results reported to date indicate some concentrations may be petroleum related while others are biogenic. Trawl samples of zooplankton and ichthyoplankton in the oil field and in the control area show more organisms collected per hour and the highest percentage of total number of species in the oil field area. Ichthyoplankton diversity was greater in the oil field area than in the control area. In summary, the impacts of discharged formation water from the production phase probably should not have a significant impact on the zooplankton populations in the Southern California Bight.

The major potential impacts on zooplankton from this proposed action would be from oil spilled into the surface layers of the ocean as a result of normal day-to-day operations and accidental spills. The oil spill model results, described in Section III.A and POCS Reference Paper No. VI project five oil spills greater than 1,000 bbl over the production life of the proposed lease area from platform accidents (1.28 spills),

pipeline accidents (1.54 spills) and tanker accidents (2.18 spills). Chronic, low-level hydrocarbon sources to the ocean from this proposed action includes small spills (less than 1,000 bbl) from accidents and normal day-to-day platform operations, the chronic addition of entrained hydrocarbons from discharged formation waters mentioned above, and low-level discharges from tanker loading and offloading operations.

Other sources of hydrocarbons to the ocean in the Southern California Bight include oil and grease discharged from land sewage outfalls (from 6 to 596 bbl/day for each of 6 major outfalls); oil from major natural oil seeps (from 50 to 200 bbl/day for each of 2 major seep areas); rivers and stream runoff (from 1 to 27 bbl/day from each of 14 major rivers, creeks and drains); and other low-level hydrocarbon sources from State tidelands production, tankering, existing Federal leases and other projects discussed in the cumulative impact sections below.

Impacts on zooplankton from oil spills could range from lethal effects for high oil concentrations in the surface layers of the water column after a major spill to sublethal effects such as abnormal feeding and behavioral patterns and uptake of hydrocarbons into zooplankton by feeding. National Academy of Sciences (1975) states that there is no evidence for food web magnification for petroleum hydrocarbons in the marine environment. The following discussion summarizes the major impacts of oil on zooplankton from available data for laboratory and field studies.

From laboratory results, zooplankton, including fish and invertebrate eggs and larvae can be lethally affected by oil at concentrations greater than about 1 ppm and perhaps as low as 0.1 ppm. The effects vary by species and life stage. Sublethal effects at concentrations in the ppm range include decreased feeding behavior, inhibition and depression of growth for egg and larval stages, and interference with chemical reception mechanisms in the marine environment for orientation (see Table III.C.1.b-1). Some zooplankton and fish larvae can accumulate hydrocarbons in their tissue. Depuration rates for hydrocarbons are rapid for crustaceans and fish and slower for mollusks. Uptake of some hydrocarbon components by zooplankton has been demonstrated in the ppb range. Generally, refined petroleum products, such as fuel oil, have greater effects on zooplankton species than crude oil.

The limited number of field studies conducted after major oil spills examining the impacts on zooplankton have detected no significant impacts on the zooplankton populations. As discussed in Section II.E.2, since zooplankton distribution and abundance are so variable and patchy in time and space, it is difficult to notice significant changes greater than natural variations. Additionally, the factors influencing the biological effects of an oil spill in the open ocean are varied and complex. NAS (1975) lists the factors as: 1) how much oil is spilled, 2) the oil type, 3) the oceanographic conditions, 4) the meteorological conditions, 5) the turbidity or sediment load in the water column, 6) the season of the year and the corresponding

biological cycle, 7) the biological species involved and 8) the methods of spill cleanup.

Following the Torrey Canyon spill of 860,000 bbl of Kuwait crude oil, Spooner (1969) observed that plankton collections showed damage to pilohard eggs and larvae which floated at the water surface. Mortality was 90 percent in some regions. Since a large quantity of toxic detergents were used following this spill, Spooner was uncertain whether the damage was done by oil alone, or by a combination of oil and dispersants.

Following the Arrow incident in Chedabucto Bay, Nova Scotia, Conover (1971) observed plankton ingesting large quantities of small drops of Bunker C oil and eliminating them as fecal matter (up to 7 percent Bunker C oil by weight). Parker (1970) also found considerable quantities of oil in the guts of copepods and barnacle larvae and in their fecal pellets. Apparently the oil can pass unchanged through the digestive system and then sinks to the bottom in the denser-than-seawater feces. Therefore, animals feeding on zooplankton could be exposed to oil in zooplankton and zooplankton feces in the water column. Some of the oil could sink to the bottom and be eaten by other members of the food chain.

There were no observed impacts on the zooplankton from the 27,000 bbl Santa Barbara oil spill in January, 1969. This spill occurred when zooplankton populations are at low level in the Channel and the Southern California Bight. Heavy sedimentation runoff from an unusually severe winter storm sank a lot of the oil.

Straughan (1970, as cited by Dames and Moore, 1975) indicated that plankton after the Santa Barbara spill were probably not affected by the toxic components of the oil at sea since oil on the sea surface is influenced by wind and currents, while the plankton are only transported by the currents. Since both would be moving at different rates, the plankton would not be exposed to the oil for a long time period. However, the effects on the surface neuston communities would be more severe since they would come in direct contact with the oil. Although the neuston was not sampled in the study of the effects of the Santa Barbara spill, Straughan (1971) states that it is difficult to envision how these organisms could not be affected by oil."

Although the workers (McGinnis, 1971) who reported on zooplankton impacts after the Santa Barbara spill recognized the shortcomings of their methods and the lack of previous adequate background data to compare their results, Connell (1973) in a critique of the report stated that the shortcomings of the methods did influence the overal assessment of little damage to the marine environment in the Santa Barbara Channel. Connell (1973) concluded that "the plankton...wer

sampled and reported in such a way as to make it impossible to decide whether there was or was not an effect of oil."

Zooplankton were contaminated during the Argo Merchant oil spill off the New England coast (Grose and Mattson, 1977). Copepods were observed with oil on feeding appendages, in alimentary tracts, and on the surface of the body. Chemical analysis of the oil in alimentary tracts and fecal pellets for those species collected within and adjacent to the spill area showed that the oil was similar to Argo Merchant oil. The presence of petroleum residues in copepods collected on 23 February 1977 (70 days after the grounding of the Argo Merchant) indicates that the Argo Merchant oil persisted in the food web (Grose and Mattson, 1977).

Preliminary evidence following the Argo Merchant spill indicates that oil had some effects on eggs and larvae (Grose and Mattson, 1977). Mortalities in developing cod and pollock embryos were highest near the Argo Merchant. Genetic damage was greater in pollock eggs than cod eggs. Laboratory experiments revealed that No. 6 fuel oil (the type of oil the Argo Merchant was carrying) will cause mortalities and retarded development of cod eggs at concentrations between 100 to 500 parts per billion. Six species of fish larvae were collected: sand launce, cod, pollock, rockling, hake and herring. Of these species, only sand launce was abundant. The abundance of sand launce decreased sharply at the two sampling stations within the spill area, probably due to the impact of the oil (Grose and Mattson, 1977).

Straughan (1977) reported on a field investigation of sublethal effects on marine organisms living in an area of natural oil seeps around Coal Oil Point in the Santa Barbara Channel. Her data show that marine invertebrates can live and breed in areas chronically exposed to petroleum hydrocarbons at higher concentrations than recorded around producing oil platforms. Straughan (1977) stated that her investigations support the conclusions of the Gulf Industries Research Consortium (1974) in the Gulf of Mexico.

The most significant impacts of major oil spills on the zooplankton in the area would be in the spring and summer months when standing crop is highest. Severe kills of zooplankton or fish eggs and larvae from a large spill would damage only the zooplankton in the surface layer of the ocean, or the neuston community. Sublethal effects could include disruption of feeding behavior, growth inhibition to some larvae and egg stages and intereference with chemical reception. Lethal effects would occur only if concentrations were greater than about 0.1 to 1 ppm in the water column. Anchovy larvae feeding at the surface at night could ingest oil as they gulp for air to fill their swim bladders. Vertical migrating euphausid shrimp and copepods could ingest or take up oil and transport it to deeper layers in

the water column. If dispersants are used to maintain the oil in the upper 3 to 4 m (9.9 to 13.2 ft) of the water column, the zooplankton in this layer would be exposed longer to the oil and dispersant-oil mixture. These impacts are a worst case prediction and cannot be supported from field investigations after oil spills. Zooplankton have been observed to accumulate oil in the field after a major spill (Grose and Mattson, 1977) but the effects of this accumulation are presently unknown.

Michael (1977) concludes that there has been no strong evidence for major damage to plankton communities as a result of an oil spill. The two factors operating to minimize effects of oil on plankton are: 1) all fractions that enter the water column disperse rapidly so that concentrations are usually very low, 2) plankton populations typically have rapid regeneration rates and usually cover large geographic areas. Even if one assumed 100 percent mortality at the site of a spill, it would be difficult to demonstrate the significance of effect on the overall population (Michael, 1977).

Therefore, the projected 1.28 platform spills greater than 1,000 bbl over the production life of the proposed action probably should not have a significant impact on the zooplankton populations in the Southern California Bight. The effects might be acute for a short time under the slick at the very surface layer of the ocean, but the zooplankton populations should recover in the area in a few months or by a year at most. The implication of the Southern California Eddy discussed in Chapter II.E.2 for cumulative impacts in the Southern California Bight is important. Since the water is recirculating in the Bight, any introduced pollutants are not completely washed out of the area during certain periods, but might be recirculating and cumulatively affecting the entire marine ecosystem.

Chronic oil spill impacts on zooplankton in the open ocean are unknown. The chronic, long-term input of oil from natural seeps in the area, land runoff, sewage outfall discharge and tanker spills, greatly exceed hydrocarbon input from offshore production from this proposed action. SAI (1978) measured concentrations of hydrocarbons in surface and bottom water in the Southern California Bight in 1976, ranging from 0.03 mg/l to 80 mg/l (0.03 ppb to 80 ppb). Figure III.C.1.b-1 gives the reported concentrations. For hydrocarbon concentrations in this range, some sublethal effects on the zooplankton could occur as discussed above. The overall effects could be to reduce species diversity in some highly oiled areas and increase the abundance of more tolerant opportunistic species. However, these effects have not been observed in the open ocean.

<u>Transportation Phase</u>. Impacts on the zooplankton from the transportation phase, in addition to the production phase impacts already discussed, would include increased oil spills from tanker and pipeline accidents and turbidity effects from burying pipelines.

The oil spill model predicts 1.54 pipeline spills and 2.18 tanker spills for the area compared to 1.28 platform spills for major oil spills greater than 1,000 bbl. Therefore, the impacts of spilled

oil on plankton, would be greater in the transportation phase. The areas most heavily impacted from these projected tanker and pipeline spills would be the Santa Barbara Channel area, the Tanner-Cortes Banks area, and the San Pedro Bay area. The oil spill impacts discussed above for the zooplankton would likewise be most significant in the spring and summer months in the ocean surface layers. The tanker transport scenarios have the potential of increasing the chance of a large spill over a broader geographic area. Zooplankton populations off Central California would be vulnerable to tanker spills from this proposed action.

Similar to the production phase, projected tanker and pipeline spills greater than 1,000 bbl should not have significant impacts on the zooplankton population in the study area. Lethal and sublethal effects in the surface layer under the oil spill could be acute for short time periods, but the zooplankton population should recover in the affected area in a few months or by one year after the incident. The significance of long-term chronic effects is unknown, but the effects could be similar to those discussed under the production phase.

The impacts on zooplankton from pipelines buried in the shallow water would be low. It is estimated that 68 km (42.5 miles) of pipeline would be buried along the pipeline routes shown in Section III.A.2. A total of 137,000 cubic meters (179,000 cubic yards) of sediment would be excavated by jet sled and clamshell dredging. This would occur 4 to 5 years after the proposed sale. The sediment plumes and increased turbidity associated with this activity could produce insignificant, local turbidity effects interferring with feeding mechanisms in the plumes. The effects could last for a few hours in each water parcel and could extend along a zone about 50 m (165 ft) wide along the pipeline corridor. The total time to bury 68 km (42.5 miles) of pipeline would be about 45 days.

iii. Impacts on the Southern California Bight

Santa Barbara Channel. Turbidity and toxic effects from drill cuttings, drilling muds, sewage waste and formation water discharges and pipeline burial would have low impacts on zooplankton populations in the Santa Barbara Channel as a result of development from this proposed lease sale. Generally, any effects would be maximum during the production phase with peak production occurring about 8 years after the sale. Muds and cuttings discharges would stop by 10 years after the proposed sale when all exploratory and development wells would be completed. Formation water discharge would be greater during the last year of production, while sewage waste discharge would remain at a fairly constant rate of 20,000 gallons per day total for the 10 projected platforms by 8 years after the proposed lease sale.

Acute and chronic oil spills would have the most impact on the zooplankton of all the impacts considered from this proposed action, as discussed above. The oil spill model predicts 3.1 spills greater than 1,000 bbl and 6.05 spills from 50 to 1,000 bbl to occur in the Channel during development from this proposed sale over the projected 25 year life of the fields. The greatest number of spills would occur during the transportation phase from projection pipeline and tanker spills (see Section III.A.4 and POCS Reference Paper No. VI). As discussed above, any lethal effects on zooplankton would be concentrated in the surface layers. Any effects would be short term and most significant in the spring and summer months when zooplankton production and standing crop is greatest. Spills reaching the Point Conception area would affect the historically highest area of zooplankton abundance for the Channel. From the oil spill trajectory probability tables in POCS Reference Paper No. VI, spills from proposed leases, tanker routes, and pipeline corridors in the Channel would most likely hit the southern part of the Channel around the northern Channel Islands.

With the two large surface current gyres in the Channel, oil spills would probably remain in the open ocean for some time. After 3 days of evaporation and dispersion, most toxic fractions would be greatly diminished. Generally, within 48 hours of a spill, 40 to 60 percent of the spill would evaporate (Slack, Wyant and Lanfeat, 1978). Within 10 days most of the spill could be cleaned up or contained, if conditions were favorable. If nontoxic dispersants are used, the oil could be kept in the upper 3 to 4 m (9.9 to 13.2 ft) of the water column for a longer time period. The impact on the zooplankton from oil dispersant mixtures are unknown, but are assumed to be no greater than the oil effects alone, since EPA now approves all dispersants to be used.

As discussed previously, the chronic, long-term impacts on the zooplankton from major and minor oil spills over the projected 25-year production life from this proposed sale are unknown. Studies in the Gulf of Mexico have found no significant or measurable impacts on zooplankton standing stocks from offshore oil production in the area (Gulf Universities Research Consortium, 1974).

<u>San Pedro Bay</u>. This area has the third highest projected resource value for this proposed sale. Oil production will peak at 7 years after the proposed sale, or in 1986. The impacts on the zooplankton from discharges and pipeline burial would be similar to the Santa Barbara Channel, except at a lower magnitude. Muds and cutting discharge would stop by 11 years after the proposed sale and formation water discharges would be greatest during the last year of production. Sewage water discharge would remain at a fairly constant 6,000-gallon-per-day-rate after 1986 for the 3 projected offshore platforms. The oil spill model predicts only 0.47 spills greater than the 1,000

bbl and 1.38 spills from 50 to 1,000 bbl to occur in the San Pedro Bay area during development from this proposed sale over the projected 25-year life of the field. The impacts on the zooplankton population in the area would be similar to those discussed for the Santa Barbara Channel, except at a lower level since the predicted number of spills is very low. Any effects would be most significant in the spring and summer when zooplankton standing crop is greatest. In the spring, a major oil spill could impact large concentrations of surface feeding anchovy larvae at night. The anchovies feed on dense concentrations of dinoflagellates that occur in the area out to 40 km (24.8 miles) from the coast. However, with the low number of spills predicted for this area from the proposed sale, this impact would be low.

Dana Point-San Diego. This area has the fourth highest projected resource value for this proposed sale. Oil production would peak at 7 years after the proposed sale, or in 1986. The impacts on the zooplankton from platform and drilling rig discharges would be low. Muds and cutting discharges would stop by 1988, and formation water discharges would be greatest during the last year of production. Sewage waste discharges would remain at a fairly constant 6,000-gallon-per-day-rate after 1986 for the 3 projected offshore platforms for the entire area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.17) and an insignificant number of 50 to 1,000 bbl spills (0.29) to occur in the area over the projected 25 year life of the field. Any oil spill impacts on the zooplankton would be similar to those discussed for the San Pedro Bay area except at a lower magnitude.

Santa Rosa Area. This area has the fifth highest projected resource value for this proposed sale. Oil production would peak at 7 years after the proposed sale, or in 1986. The discharges from the projected 1 production platform and the exploratory activity for 3 exploratory wells would have an low impact on the zooplankton populations in the area.

The oil spill model predicts an insignificant number of oil spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.17) over the projected 25-year life of the field. Therefore, impacts on zooplankton in this area from oil spills would be low.

Tanner-Cortes Area. This area has the second highest projected resource value for this proposed sale. Oil production would peak in 1986. The impacts on the zooplankton from discharges and pipeline burial would be similar to those discussed for the Santa Barbara Channel. Muds and cutting discharges would stop by 1990 and formation

...er discharge would peak during the last year of production. Sewage waste discharge will remain at a fairly constant 18,000-gallon-per-day rate after 1986 for the 9 projected offshore platforms.
day rate after 1986 for the 9 projected offshore platforms.

The oil spill model predicts 1.14 spills greater than 1,000 bbl and 3.17 spills from 50 to 1,000 bbl from this proposed sale over the projected 25 year field life. Short-term, lethal effects on zooplankton in the surface layer would be most significant in the spring and summer months when standing crop is high. Since the predominant wind direction and surface current flow in the area is to the southeast, most spills occurring in the area would be carried south and southeast. Impacts from acute and chronic spills would be similar to those discussed for the Santa Barbara Channel.

<u>Santa Barbara Island Area</u>. This area has the lowest projected resource value for the proposed sale. Production would peak in 1986. Discharges from the projected 1 platform and the exploratory activity for 2 exploratory wells would have a low impact on the zooplankton population in the area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.09) over the projected 25-year life of the field. Therefore, impacts on zooplankton in this area from oil spills from the proposed action would be low.

Baja California Impacts: The only impacts on zooplankton population off Baja California from this proposed sale would be from oil spills from proposed lease areas drifting down with the southeasterly flowing California current. Any spills reaching the waters off Baja would be greatly weathered with most toxic fractions dissolved. The greatest number of potential spills from the southernmost lease would be 1.14 predicted from the Tanner-Cortes area and 0.17 predicted from the Dana Point-San Diego area. The oil spill model predicts very low (less than 5 or 10 percent) or negligible hits on land segments or resources in the Baja area from oil spills in the Southern California Bight. Therefore, the impact on zooplankton population off Baja would be low. Any impact would be greatest during the spring and summer months when upwelling is strongest, phytoplankton productivity and standing crop is greatest, and zooplankton concentrations are high.

Central California Impacts: The only impacts on zooplankton populations off Central California from this proposed sale would be from oil spills from tankering production from the Santa Barbara Channel and Santa Rosa and Tanner-Cortes Bank area. The oil spill model predicts only 0.65 spills greater than 1,000 bbl for the Ventura and

San Francisco tankering leg. The transportation phase would start in 1982 or three years after the proposed sale. Production for the proposed sale area would peak about seven years after the proposed sale or in 1986. The probability tables in POCS Reference Paper No. VI for Central California predict probabilities of less than six percent for spills reaching Central California land segments or resources from this proposed sale. Any spill along tankering leg Tg, T10 and T12, shown in Figure 1-A of POCS Reference Paper No. VI would have the greatest probability for impacting coastal zooplankton populations.

If a spill occurred along the tankering leg, it would have the most impact on zooplankton population during the spring and summer. Since the predicted oil spills from this proposed sale are very low for this tankering leg, any impact on zooplankton populations would be low.

Cumulative Impacts

Southern California Bight. The related projects considered for cumulative impacts in the area along with the projected action are described in Section I.C.5. The greatest additional OCS oil and gas activity from existing and proposed Federal and State development will be in the Santa Barbara Channel, followed by the San Pedro Bay area and the Tanner-Cortes Bank area. The Santa Rosa area and Santa Barbara Island area, will have associated OCS development from Federal Sale 35, while the Dana Point-San Diego area will have no leases additionally existing or projected OCS development besides from this proposed sale. Increased tanker traffic in the Santa Barbara Channel and San Pedro Bay area will result from existing impacts of foreign crude, additional tankering of Alaskan crude through the Santa Barbara Channel to Long Beach, tankering of Elk Hills oil production from Port Hueneme to Long Beach and San Francisco through the Santa Barbara Channel, and LNG tankering, either in the Santa Barbara Channel or in the San Pedro area.

Additional cumulative impacts on the zooplankton populations in the Bight from drill cuttings, drilling muds, sewage water and formation water discharge and sedimentation effects from pipeline burial would probably be low. Any effects would be similar to those discussed previously. The recirculating effects of the Southern California Eddy are unknown.

The additional cumulative impacts on the zooplankton from acute and chronic oil spills would probably produce the greatest effects. The oil spill model predicts a total of 19 oil spills greater than 1,000 bbl and 42.76 spills from 50 to 1,000 bbl from proposed Sale No. 48, existing Federal leases and tankering of Alaskan and foreign crude into the area. This does not include spills from existing and projected State tideland development within three miles of the coast. The model predicts a total of five greater than 1,000 bbl

oil spills from proposed Sale No. 48 development, 9.3 spills from existing Federal OCS leases, and 4.7 spills from Alaska and foreign tankering. Oil spills from 50 to 1,000 bbl size are predicted as 11.15 spills for proposed Sale No. 48 development and 31.61 from existing Federal leases and tankering of Alaskan and foreign crude The projections assume a pipeline-tanker transportation mix for offshore production from proposed Sale No. 48 and existing Federal leases. If 100 percent of the oil production is tankered from proposed and existing Federal leases, the model predicts 11.6 greater than 1,000 bbl spills of the Bight versus 14.3 greater than 1,000 bbl oil spills from a mix of pipeline and tanker transportation.

As mentioned previously, the greatest potential for additional oil spill impacts on the zooplankton would be in the Santa Barbara Channel area (9.63 greater than 1,000 bbl spills and 18.78 50 to 1,000 bbl oil spills) followed by the San Pedro Bay (4.96 greater than 1,000 bbl spills and 14.56 50 to 1,000 bbl spills) and the Tanner-Cortes Bank area (3.67 greater than 1,000 bbl oil spills and 8.14 50 to 1,000 bbl oil spills).

The cumulative oil spill impacts on the zooplankton in the Santa Rosa, Santa Barbara Islands and Dana Point-San Diego areas would be low. All of these predicted spills are totals projected over the expected 25-year life of the field.

The cumulative impacts on the zooplankton from the predicted major and minor spills in the Santa Barbara Channel, San Pedro Bay and Tanner-Cortes area are unknown, but thought to be low for acute spills. As discussed previously, oil spill impacts from acute spills could have some lethal and sublethal effects on zooplankton in the near-surface layer of the water column. These impacts would be short term and the zooplankton should recover from any effects within a few months to a year. Plankton populations in general have relatively short life cycles and rapid reproductive rates. Also, since they extend over the entire area and are moving constantly with the currents, it would not be possible to wipe out a significant portion of the population even with a major spill.

The chronic, long-term effects of additional oil spills from the proposed and related action are unknown. Investigations by the Gulf Research Consortium (1974) in the Gulf of Mexico reported no significant effects on zooplankton standing crops in an area heavily developed by OCS oil and gas activity over many years. Overall, the long-term chronic additions and hydrocarbons to the marine environment in the Bight from the proposed and related actions must be put in perspective to the large daily oil seepage from natural seeps over thousands of years (40 to 670 bbl/day estimated for the Santa Barbara Channel above), the large daily oil and gas discharges from land sewage outfalls (6 to 596 bbl/day estimated for each of

six major outfalls), and oil runoff from rivers, creeks and drains from land (1 to 27 bbl/day from 14 major sources). The implication of the Southern California Eddy, discussed in Chapter II.E.2 for cumulative impacts in the Southern California Bight, is important. Since the water is recirculating in the Bight, any introduced pollutants are not completely washed out of the area during certain periods, but might be recirculating and cumulatively affecting the entire marine ecosystem.

Baja California. The only additional, cumulative impacts on zooplankton populations off Baja California would result from additional oil spills reaching the area. Any spills reaching the waters off Baja from the Southern California Bight would generally remain offshore and be in a dispersed, weathered state. The impacts on zooplankton would be low.

Central California. Once again, increased oil spill impacts from tankering would be the only major effect on zooplankton populations. The increased tankering from Alaskan crude and cumulative oil production from the Santa Barbara Channel and Tanner-Cortes Bank area would increase the probability of spills along tanker legs Tg through T12 and T1 through T4 (see Figure 1-A in POCS Reference paper No. VI). Impacts on the zooplankton from acute spills would be short term and low. Long-term, chronic impacts on zooplankton from spills associated with increased tanker traffic along the coast are unknown.

In summary, the impacts from this proposed sale on the zooplankton populations in the study area should probably not be significant for short-term effects. As discussed previously, long-term effects are unknown. Major adverse impacts could include local, minor reductions in zooplankton abundance around drilling rigs and platforms from discharges into the ocean; short-term decreases in zooplankton abundance in the near surface layer of the ocean under a major oil spill; and unknown long-term effects from chronic oil spills and other discharges over the development life of the fields, or from 25 to 40 years after the sale date. The greatest impacts would occur in the Southern California Bight in the proposed lease areas with development activities in the Santa Barbara Channel area producing the most impacts since the Channel has the highest projected resource potential and the greatest number of predicted oil spills from this proposed sale. Impacts on zooplankton populations off Baja and central California would probably be low to insignificant.

Seasonally, the greatest impacts from oil spills on zooplankton in the ocean surface layer would be in the spring and summer months when zooplankton standing crop is greatest. Over time, most impacts would be concentrated in the production and transportation stages. Impacts from areas already leased and from other related projects would be greater than impacts on the zooplankton from this proposed sale. Because of the natural variability of zooplankton abundance in the dynamic ocean surface layer, major adverse impacts would probably not be measurable in the open ocean environment.

b. Impact on Benthos

i. Subtidal

Overview. Environmental impacts which may be expected to affect benthic life adversely will result from the discharge of drill cuttings, accidental spillage of oil (and associated use of emulsifiers) and other toxic materials, and the burial of newly-constructed pipelines. A description of the marine benthic communities may be found in Section II.E.3, and POCS Reference Paper No. III.B.

Spilled oil which has not evaporated, been cleaned up or stranded on a beach, after being dispersed into the water as droplets, adheres to particulate matter and sinks to the bottom where it comes into contact with the benthos.

Data of Sanders, Grassle, and Hampson (1971) show immediate and nearly complete mortality of many forms of benthic animals following the spill of No. 2 fuel oil near West Falmouth, Massachusetts.

This indicates that under the right conditions petroleum hydrocarbons can cause a severe impact on the benthos. The conditions at West Falmouth involved a more toxic refined oil and shallow depths in an area having restricted circulation. What about the benthos of the California Bight where the benthos occur in deeper water and the oil would be the less toxic crude? There were benthic investigations after the 1969 Santa Barbara oil blowout in an area which had some baseline data (Allan Hancock, 1965). These data, however, had been collected approximately 10 years previously and it was sometimes difficult to determine if the changes in the benthic communities were attributable to the spill or other unknown factors.

According to Fauchald (1971) the standing crop biomass of the echiuroid worm *Listriolobus* pelodes in the Santa Barbara Channel decreased dramatically over a 10-year period since the Allan Hancock Foundation (1965) study. The standing crop of other organisms was less affected, including that of the brittle star *Amphiodia urtica*, the other dominant of the area (Wintz and Fauchald, 1971). This decrease could not be attributed to the Santa Barbara oil blowout, although it was suggested as a possibility (together with increased sewage pollution, drilling and change in sediment). Because of the long period of time between the studies, Fauchald could not determine the cause of the *Listriolobus* reduction.

When natural seepage increased during the following spring and summer, Juge (1971) found no burrowing organisms nor evidence of them in box cores taken from heavily oiled sediment near Platform

A. Fauchald reported that a relatively small, but otherwise normal, *L. pelodes* was found sitting in its shallow depression surrounded by an inch thick layer of black mud mixed with crude oil in one of Juge's cores.

Carlisle, et al., (1964) reported a cuttings pile had little or no affect on the fish population by tower Hazel near Santa Barbara. Encrusting organisms were covered by mud during jetting operations conducted to reduce the pile which had become too high for disposal operations. A diver survey during one operation offshore Louisiana revealed that the drill cuttings on a soft bottom could be detected over a circle 100 feet in diameter. In a small area in the center, the deposit appeared to be about four feet thick. The same survey of the cuttings deposit showed that benthic animals either migrated up through the deposit as it accumulated or colonized even as deposition continued, because it appeared to be inhabited by several animals characteristic of "normal" benthic fauna (Henry Hill, Continental Oil Company, personal communication). No study on the actual mortality was conducted. It is our opinion that the 100-foot diameter pile of cuttings may represent cuttings from one or a few wells. The total amount of cuttings from 20 to 30 wells would probably cover a larger area around the base of a platform. The distribution of these cuttings would depend on currents and on size of the cuttings which, in turn, is largely dependent on the sediments themselves. Drilling would result in turbidity and the possibility of some burial and smothering, especially near bottoms which are firm enough to support an epifaunal community. Occurring in relatively hard sandy bottoms are small to large populations of non-burrowing, attached benthic animals as the sponges, anemones, bryozoans, and other epifauna. The extent and duration of the impact are nearly impossible to predict at this time. If the drill cuttings are similar in consistency and composition, colonization and repopulation could proceed normally. If, on the other hand, the drill cuttings are wholly foreign in consistency and composition, the deposit might remain barren for a long period or be populated by different types and numbers of animals.

The effect of drill cuttings may be further complicated by the periodic discharge of non-oil based drilling muds. The most common fluids or muds are water-base clay suspensions, with ferrochrome or chrome lignosulfonate added to control viscosity and fluid loss, and barite added to increase fluid density.

Concerning the toxicity of drilling muds, there is evidence both ways. In upland operations barium compounds have a severe, almost sterilizing effect on plant and animal life in the soil (EPA, 1972).

Investigating on behalf of the Gulf Universities Research Consortium Offshore Ecology Investigations (1974), Dr. James I. Jones has

found barium compounds to be above "normal" background levels in sediments of Grand Isle, Louisiana, where drilling has gone on for many years. Nevertheless, they were low enough to present no known biological hazards. Based on the results of Jones' study, it appears that, when considered spearately from drilling muds, regular discharge of drill cuttings will not result in a reduction of the benthic communities of the continental shelf.

The other element of concern has been chromium. According to McAuliffe (1976) aqueous solutions of ferrochrome or chrome lignosulfonates have toxicity, but they adsorb onto clays and barite thereby lowering their toxicities.

Overboard loss or discharge of drilling fluids would introduce some of this chromium into the marine environment. Sodium lignosulfonate, however, has largely replaced chromium lignosulfonate in commercial muds used in Pacific waters. To mitigate any potential use of ferrochrome or chrome lignosulfonate as drilling mud additives, USGS will restrict these additives from future use in the Pacific OCS region. Studies relating to toxicities of organic compounds containing chromium suggest that chrome lignosulfonate, in moderate to strong dilution, is relatively harmless. While readily soluble in sea water, the compound apparently dissociates very little. If inorganic chromate is also present in the drilling mud, however, oxidation of the chrome lignosulfonate occurs, evolving a new organic chromium complex (Skelly and Dieball, 1970). The nature of this new phase is not well understood.

Jessen and Johnson (1963) discussed physical adsorption and ion exchange relations between chrome lignosulfonate and clay components of drilling muds. Their work agrees with McAuliffe's and indicates a strong tendency towards adsorption rather than in exchange of all chrome species present in the muds tested. Transfer mechanisms affect the removal of chrome components from the water column with subsequent deposition as clay sediment. Once on the sea floor, chrome lignosulfonate is fairly resistant to biodegradation, however, certain benthic invertebrates are known to concentrate trace amounts of various heavy metals over extended time. The possible role of drilling mud chromium additives in this phenomenon should not be ignored. Recent industry tendencies toward maximum recovery of chemical additives will minimize potential hazard to life of species while relevant experimental data accumulates. Also, as mentioned above, sodium lignosulfonate has largely replaced chromium lignosulfonate in commercial muds used in Pacific waters.

In water depths between 12 and 200 feet new pipelines are entrenched by jetting away the sediment beneath the pipe and allowing the pipe to settle into the underlying trench or held in place by rip-rap. Subsequent burial is allowed to take place naturally, primarily by reworking of sediments by bottom currents. The jetting process physically disrupts the sediments in its path and also causes resuspension of large quantities of sediment.

Most, if not all, benthic fauna are either destroyed by the jetting or raised into the surrounding water and rendered completely vulnerable to predation. Although recolonization would begin immediately, the native fauna could not be restored until seasonal reproduction cycles had been completed by representative species from adjacent areas, which would provide a supply of larvae to settle and enter the reworked substrate.

Turbidity resulting from resuspended sediment is capable of producing an adverse impact on filter-feeding molluscan and crustacean benthos by clogging the filter-feeding apparatus or blocking respiratory surfaces.

Another possible source of impact during pipeline dredging is the resuspension of toxic heavy metals and persistent pesticides. Pipelines transversing the San Pedro Shelf into the Los Angeles-Long Beach Harbor will will generate this type impact. The possibility exists that these toxic materials could be ingested by lower marine life and could then be magnified through the food chain until they accumulate in serious quantities in top carnivores, including species harvested for human food.

Obviously, we must conclude that the benthic community will be disrupted or destroyed in the path of pipeline dredging operations. Recovery from the impact will be accomplished in two phases. First, recolonization of the affected area will come from emigration by adults and larval settlement originating from adjacent unaffected areas. The width of the area impacted will be of such a limited distance that we do not consider recolonization an important problem. Second, the time required to establish a breeding population will depend upon substrate, mobility of the involved species, and the length of time required to reach sexual maturity. Initial recolonization will begin, by emigration and larval settlement, within weeks or even days after the impact. Repopulation originating from within the affected area by non-motile species will begin within months to at least five years. The latter time period is based on the assumption that there are subtidal species which require as long as stalked barnacles (*Pollicipes polymerus*) to reach sexual maturity (Straughan, 1971). The probability of impact by resuspended toxic heavy metals and persistent pesticides exists, but the scope and duration of the impact are unknown.

The areal impact due to jetting would be limited to less than 40 m of bottom, while that of blasting would be only slightly larger, the exact distance being hard to predict.

According to Dames and Moore (1973) the alternative to burying the pipeline in the inshore regions is to lay the pipe on the surface and securely anchor

it in place with a cover of rip-rap (rock, concrete blocks or concrete bags). Where the pipeline and rip-rap are placed on the bottom, epifauna, such as sea stars, brittle stars, and sea urchins, may be crushed, but infauna (animals living in sediments) would be relatively little affected. Rip-rap, independent of the material utilized, would soon (probably within a year) be colonized by the characteristic fauna and flora naturally inhabiting permanent substrate in the area. Besides providing additional habitat for game fish, the rip-rap should be especially attractive to abalone and lobsters because of the abundance of cavities.

It should be recognized that whenever a hard bottom habitat is created through platform construction or pipelines and rip-rap, a portion (usually somewhat larger than the artificial structure) of the soft bottom community is destroyed.

In sediments, chemical degradation of oil can occur but is restricted to the surface layer of the bottom penetrated by ultraviolet light. Ahearn (1973) stated that research on microbial utilization of hydrocarbons for treatment of oily pollutants in the environment, though more intensive in recent times, is still in an early stage of development. It is known that microorganisms can degrade much of the crude oil, particularly the less toxic paraffinic compounds. No single species can degrade all the compounds, but many different species together can metabolize a large number of the compounds, if not all. The rate of microbial degradation, which is principally aerobic, decreases with a decrease in temperature. Large quantities of oxygen are needed. It has been estimated, for instance, that complete oxidation of 1 gallon of crude oil would require all of the dissolved oxygen in 320,000 gallons of water. This comparison may be unrealistic because most oil is at the surface of water in contact with air and only the outer surfaces of oil can be attacked at any one time. It is reasonable to assume however, that an oxygen-deficient environment may well occur under some oil slicks and in oil-contaminated sediments.

Much of the oil from the Santa Barbara blowout is believed to have settled in the Santa Barbara Channel (Battelle Northwest, 1970) where oxygen is already deficient and is probably not present in sufficient quantities for further decomposition. Since the basins are settling sinks for sediments and probably oil, part of the oil from an oil spill will settle in one of the basins. Hartman (1960) reported the number of species and standing crop in the basins is far less than that of the shallower shelves. Jones and Fauchald (1977) confirmed Hartman's results except for their inconsistent results of standing crop. Because of the more sparse distribution

and possible greater sensitivity of many of the basin benthos, oil on the bottom here could cause a greater impact on the basin community than a shallower shelf community. Conversely, particularly the inner basins have been receiving oil for hundreds of years from natural oil seeps. Perhaps spills in the inner basins would have less of an impact than on one of the outer basins, not as subject to years of natural oil settlement.

Extremely heavy doses of oil, especially of refined oil, can cause disruption of the sediments (Blumer, Sander, Grassle, and Hampson, 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals. The resulting erosion spread hydrocarbons to new areas, where the process was repeated.

Newell (1948) and Valentine (1966) suggested that a significant number of endemic molluscs, some with a distribution restricted to 1° or 4° latitude, occur within the California Bight. This endemism also occurs in other taxonomic groups (Newman, personal communication, 1974). Newell obtained his data from the list compiled by Keen (1937). The names of the endemics occurring from Point Conception to the Mexican border from Keen's report are available at the Pacific OCS office but are not included in this EIS because of space restrictions. Valentine updated his data from a variety of sources, chiefly Bunch (1944-1946). Valentine reported 180 species of Bivalvia and Gastropodia, alone, had a north-south geographic range of only 96 km (60 miles) within the Bight area.

Many of the endemics, of course, are not valid species because of the little sampling which has been done north and south of the American Southern California Bight, inaccurate identifications. According to Newell (1948) species close to the edges of their range may hybridize with closely related species or acquire atypical forms because of the less than optimal environmental conditions which occur at the edge of their range. By far the largest number of species were of the difficult to identify gastropod family Pyramidellidae of which Odostomia is probably the best known example. In spite of these problems with accurate species identification, endemism is a real and valid occurrence in the proposed lease area.

It is easy to speculate the obvious implication of this: severe or chronic alteration of comparable areas of the environment could eliminate endemic species forever. It is doubtful that a single large spill could wipe out many if any subtidal benthic species by itself. The effect of wide-spread chronic oil pollution or a large oil spill in combination with other types of environmental alterations is not known, but would probably contribute to the extinction of some of these endemics.

In conclusion, impacts resulting from: 1) Drilling will cause smothering and burial (especially near bottoms firm enough to support an epifaunal community) for a distance 30 m (100 feet) or greater. Recovery will usually begin within months but biological recovery will not be complete for the epifauna communities for at least 5 years. 2) pipeline burial will result in community disruption and destruction in the path of the 126 km (7.5 miles) of pipeline corridor construction. Destruction will be minor and be limited to a diameter of about 30 m (100 feet) along the pipeline path. Recovery should occur in a matter of days or weeks in the more numerous softer bottoms where benthic organisms have mobility abilities. For sessile organisms in kelp beds and harder bottoms, recovery will take from 1 to 2 years (for kelp) to 5 years. 3) Resuspension of polluted sediments will result if pipeline laying or drilling operations occur on the San Pedro Shelf. Direct kill to benthic organisms will be of limited but unqualifiable extent and duration. Pesticides could be accumulated in the food chain as the result of drilling in these areas. This could be detrimental to certain individuals at the top of the food chain, although no widespread population fluctuations will result from these operations. 4) A large oil spill with a maximal amount of sinking oil will probably have minor impacts on the subtidal benthos, the extent of which is not known. Complete destruction of the benthos is not anticipated, but certain extremely sensitive species, particularly microcrustacens and shallow water endemice may be eliminated or greatly reduced from the area covered by oil. The impact of spilled oil eventually ending up in the basins is unknown. Natural oil seeps also end up in the basins (California State Lands Commission, 1974) and, although the oils are often of a slightly different composition, spilled oil is not expected to harm the overall community structure although some very sensitive species may be harmed. The impact of a small 500 barrel spill wil be negligible, although the impacts from prolonged, chronic pollution is not really known.

Santa Barbara Channel Area Impacts. The oil spill model gives no probabilities which can be effectively used in the discussion of the benthos. The expected number of spills can be used to estimate the number or frequency of oil spills during the life of the lease operations.

The impacts from the placement of platforms, drill cuttings, formation water or dilling muds, pipeline excavation, and oil spills to the benthos have been summarized above and will be referred to during the area-by-area analysis of impacts.

As suggested above, although oil can be extremely detrimental to benthic organisms, the great depth, abundant circulation and extensive area of the Bight help dilute the oil so much that an oil spill and probably even slow continual discharge of oil in formation water, etc., will probably have little impact on benthic assemblages. Nevertheless, oil becomes sorbed to sediment particles and sinks to the bottom, creating at least a potential for impact.

Microcrustaceans, particularly amphipods (and especially ampeliscid amphipods) have been reported to be very sensitive to oil contamination. Since the BLM study has documented the distributions of the most frequently occurring microcrustaceans at so many proposed and existing lease areas, it can be valuable to point out which of these species are in these lease areas. The species, then, have the highest potential of being impacted as the result of the sale. Although evidence suggests the probability of extensive mortality to these species is small, it is uncertain how small this probability is.

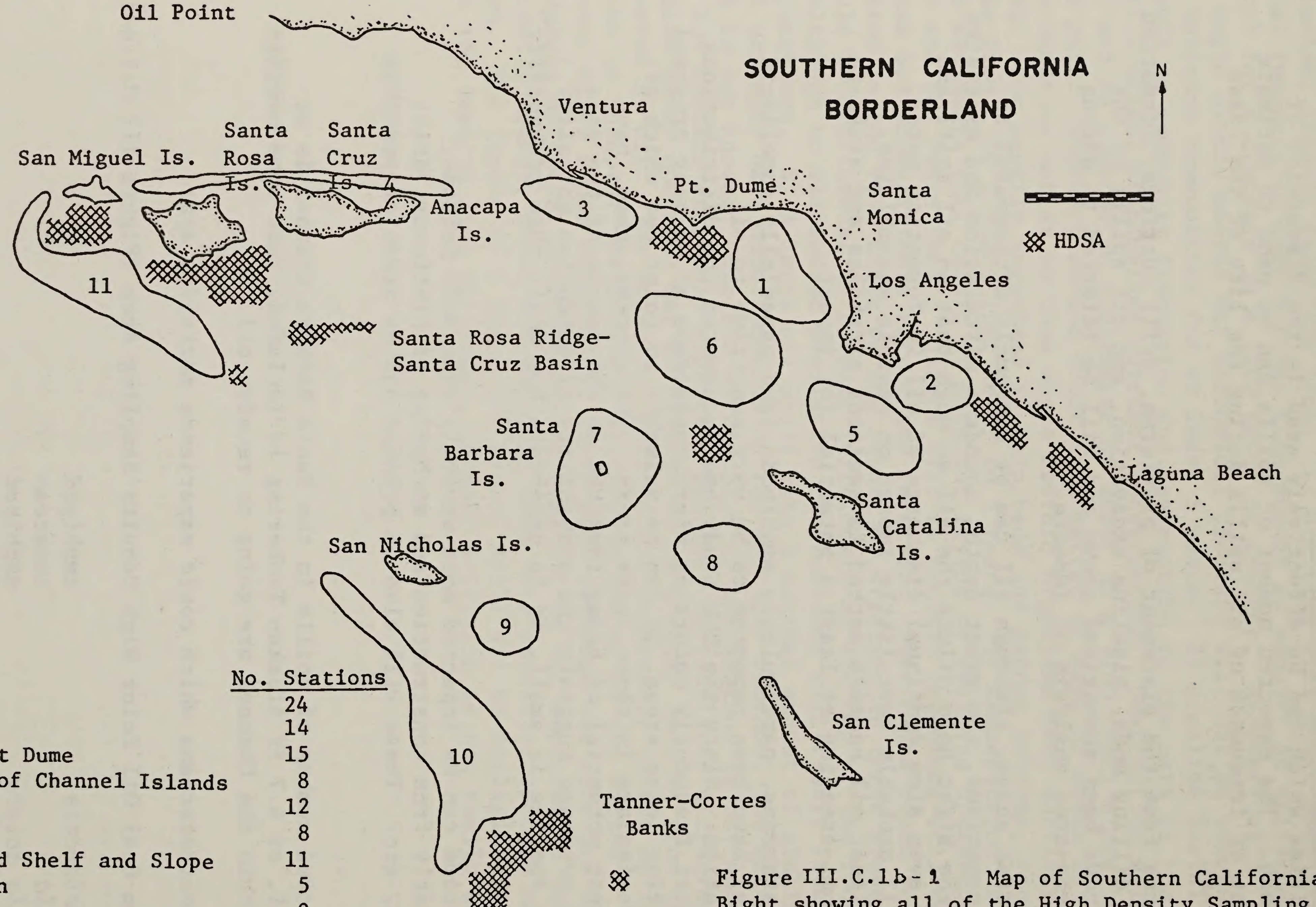
Hard bottoms can be impacted more severely than soft bottoms, particularly from construction and anchoring of platforms, drill cuttings, etc. These will also be pointed out as areas of possible impact.

The expected number of spills in the Santa Barbara Channel is so high (3.1, or 4.7 if Alaskan Tankering is included) that some benthic areas within the Channel are going to receive oil.

The microcrustaceans which could experience mortality are:

From Coal Oil Point High Density Sampling Area (Figure III.C.1.b-1)

Byblis veleronis	amphipod
Euclorella	cumacean
Listriella goleta	amphipod
Euphilomedes carchorondinta	ostracod
Euphilomedes prodricta	ostracod
Paraphoxus licuspidatus	amphipod
Heterophoxus oculatus	amphipod



	No. Stations
Santa Monica Bay	24
San Pedro Shelf	14
Shelf north of Point Dume	15
Island Shelf North of Channel Islands	8
San Pedro Basin	12
Santa Monica Basin	8
Santa Barbara Island Shelf and Slope	11
Santa Catalina Basin	5
San Nicolas Basin	9
Southern Santa Rosa-Cortes Ridge and Slope	23
Northern Santa Rosa-Cortes Ridge and Slope	13

Figure III.C.1b-1 Map of Southern California Bight showing all of the High Density Sampling Areas and Low Density Sampling Areas.

The species whose names are preceded by an asterisk are possibly somewhat distinctive of the Coal Oil Point area.

From the shelf area extending roughly from Point Mugu to just east of Point Dume, the most frequent microcrustaceans are:

Ampelisca catalinensis	amphipod
Ampelisca macrocephala	amphipod
Euphilomedes carcharondonta	ostracod
Aoroides columbiae	amphipod
Photis spp.	amphipod

The species whose names are preceded by an asterisk are possibly somewhat distinctive of the area.

From the northern shelf of the Santa Barbara Channel Islands, the most frequent microcrustaceans are:

Aoroides columbiae	amphipod
Photis californica	amphipod
Euphilomedes carcharondinta	ostracod
Zeuxo sp.	amphipod
Photis spp.	amphipod
Pardisynopia synopiae	cumacean
Byblis velerones	amphipod

It is noteworthy to point out again (see POCS Reference Paper III.B) that the Santa Barbara Channel area, particularly on all the island shelves, has far more frequently occurring microcrustacea than the areas to the south. This could be interpreted as meaning that with the greater number of natural oil seeps in the channel, benthic microcrustaceans are tolerant to chronic oil pollution. It also could mean that there are greater potentials for mortality to these species when an oil spill occurs.

According to Visual No. 9, the only proposed tract with a hard bottom is No. 065 off the Pitas Point Unit.

The near shore shallow (about 10 or 15 meters) areas have different communities than those sampled during the BLM study. The best known soft bottom community is the sand dollar community and is particularly well developed off Zuma Beach. Because of the shallow water of this community, the potential for impact could be greater than that of deeper water. Conversely, there will have been a longer time for the toxic compounds to become reduced from the oil slick. Compared with the potential impact on the intertidal, there is expected only minor impact on this community.

The use of dispersents will reduce the impact on the benthos if they are designed to suspend the emulsified oil in midwater, but increase it if they are designed to rapidly sink the oil to the bottom. The damage would not be permanent. Recovery rates are outlined in the overview part of this section.

The cleanup group for the Santa Barbara Channel area is Clean Seas, which has the capability of containing the spread of a spill (except in heavy seas) and decreasing the amount that goes on shore or into shallow waters. Most of the contained oil is skimmed off the water surface and recovered. This decreases the amount of oil reaching the bottom and also the impact.

The impacts on pipeline construction have been discussed above in the overview part of this section and are expected to be the same as summarized there. Not many pollutants are expected to be stirred up during the proposed pipeline construction, except near Ventura where the effects are expected to be minimal.

San Pedro to Dana Point Area Impacts. The San Pedro Shelf area has an expected number of spills during the life of the lease of only 0.47 as the result of Sale No. 48, but when the Alaskan tankering is considered, the expected number of increases to 2.30 which makes this area the second highest of the proposed lease. The only microcrustaceans with a fairly high frequency of occurrence in the San Pedro Shelf is the widely distributed ostracod *Euphilomedes carcharondonta*.

In water shallower than 500 m at the Huntington-Laguna Beach High Density Sampling Area the number of frequently occurring microcrustacea increases to 6 species:

Westwoodilla caecula	amphipod
Euphilomedes producta	ostracod
Euphilomedes carcharondonta	ostracod
Heterophoxus oculatus	amphipod
Paraphoxus bicuspidatus	amphipod
Ampelisca macrocephala	amphipod

Westwoodilla sp. may be somewhat distinctive of this area.

According to Visual No. 9, proposed lease tracts 120, 121, 125 and 139 or 140 have hard bottoms within them. This will cause more of a destructive impact on the bottom community during construction and anchoring of the platforms than on soft sediment bottoms.

The impacts expected from oil spills, construction on hard bottoms and the use of dispersents are summarized above in the overview and Santa Barbara Channel area parts of this section.

The group responsible for cleanup operations in the southern part of the proposed lease area is SC-PCO (Southern California Petroleum Contingency Organization). The impacts from oil containment are discussed above in the Santa Barbara Channel portion of this section.

The impacts of pipeline construction have been summarized in the overview portion of this section. The amount of toxic pollutants stirred up during this operation in waters less than 200 feet, particularly in the Los Angeles-Long Beach Harbor will be high and will cause mortalities and increased accumulation of certain toxicants in the food chain.

Dana Point to San Diego Impacts. The expected number of spills for this lease area is only 0.17, one of the lowest of all the areas. Data from BLM benthic stations within this area were not available for the draft EIS, so the microcrustacea are not known.

According to Visual No. 9, proposed Lease Tracts Nos. 141, 166 and possibly 162 have hard bottoms within them. This will cause more of a destructive impact on the bottom community during construction and anchoring of the platform than on soft bottoms.

The impacts on the benthos are expected to be similar to those summarized above in the overview and Santa Barbara Channel portions of this section.

Santa Rosa Area Impacts. The Santa Rosa area has an extremely small expected number of spills; 0.06.

The frequently occurring microcrustacea at the Santa Rosa Island High Density Sampling Area are:

Euphilomedes carchorodonta	ostracod
Photis lacia	amphipod
Photis california	amphipod
Aorordes columbae	amphipod
Ampelisca macrocephala	amphipod

Those of the shallow assemblage of the Santa Rosa Ridge High Density Sampling Area are:

Photis lavica	amphipod
Aorodes columbiae	amphipod

According to Visual No. 9, only proposed Tract No. 111 has a rocky bottom within it. The impacts on the benthos are expected to be similar to those summarized above in the overview and Santa Barbara Channel portions of this section.

Tanner-Cortes Area Impacts. The expected number of spills in the Tanner-Cortes lease area is 1.14 during the life of the lease.

The most frequently occurring microcrustaceans from the soft bottoms at Tanner-Cortes Banks are:

Bank Top

Ampelisca cristata	amphipod
Photis californica	amphipod
Aoroides columbae	amphipod
Hemilampros californica	cumaeceae

Bank-Trough

Urothoe variarim	amphipod

The biggest area of ecological interest in this area is the purple coral communities which include a myriad of associated species. This is better discussed along with the other hard bottom lease blocks under the impacts of Special Biological Areas (Section III.C.1.j).

The other area sampled during the BLM benthic study is the southern portion of the Santa Rosa Cortes Ridge. This area also includes the "fossil" mollusc *Neoplina* sp. which is the only species of the previously assumed extinct group found in relatively shallow water. From a scientific and evolutionary standpoint, it is important to preserve this species for study. As indicated above, oil lease operations probably will not destroy this species.

The microcrustaceans which could experience mortality from a large oil spill are:

Byblis veleronis	amphipod
Ampelisca catalinensis	amphipod
(*Neoplina* sp.	monoplacophora)
Urothoe vabarina	amphipod

It is even less likely this group would be harmed by an oil spill than those closer to the mainland because of the greater depth and less sediment in the water column in these essentially oceanic waters. The impacts on the benthos are expected to be similar in quality to those summarized above in the overview and Santa Barbara Channel portions of this section.

Santa Barbara Island Area Impacts. The expected number of spills (0.6) of the Santa Barbara Island area is, together with Santa Rosa Island, the lowest of the study area.

The microcrustaceans which could experience mortality from a large spill are:

Bathymeclon pumilus	amphipod
Ampelisca pacifica	amphipod
Aoroides columbiae	amphipod

The tracts which apparently contain some rocky bottom in them are Nos. 115, 117 and 119. The impacts on the benthos are expected to be similar to those summarized above in the overview and Santa Barbara Channel portions of this section.

Baja California Impacts. The details of the benthos off the west coast of Baja California are not well known, but according to available literature, are apparently essentially the same as the United States portion of the Bight. The oil spill model predicts a very low probability of a spill reaching the coast of Baja. The nearest lease tract with a very low expected number of spills 0.17 is approximately 7.2 km (4.5 miles) from Baja waters. These factors, coupled with the low probability of impact on the benthos in the lease area would make it appear that an impact on the Baja California benthos is highly unlikely.

Tankering Leg Impacts - Central California. As with Baja California, the oil spill model predicts little probability of a spill from the lease area off Point Conception, the Santa Barbara Channel, or the tankering leg to San Francisco Bay to reach shore in Central California. However, since the expected number of spills from the Santa Barbara Channel area is so high, there probably is a moderate chance of some oil from a spill reaching the bottom sediments around the southern portion of this region, particularly around Point Arguello and Point Conception. Since the results of the BLM transect off Point Conception are not available at the time this draft is written, the microcrustacea which have the best chance of suffering some mortality cannot be identified. The probability of extensive mortality is not considered to be high, however.

Cumulative Impacts. At several areas the oil spill model and expected number of spills data indicate essentially no difference between spill probabilities for Sale No. 48 and cumulative impacts. These areas will be omitted here.

There is a large difference between the expected number of spills resulting from Sale No. 48 (3.1), and the combination with existing leases (4.66). In addition, when the expected number from the Alaskan pipeline is added, the expected number is increased to 9.63. Nothing much can be added to this figure except that we can expect to have twice as many spills which for the medium to deep water benthos will still do a minimum of damage except possibly to the crustacea mentioned above.

The only other area having a significantly different expected number of spills from the cumulative operations is the San Pedro Area. As indicated in POCS Reference Paper III.B, the San Pedro Shelf area is possibly already greatly altered by human activities and the addition of 5 oil spills of, say, 1,500 barrels each over the life of this lease (approximately 20 years) is equivalent to the amount of oil and grease discharges put into the same area by domestic sewage from the Orange County and Whites Point outfalls in about 10 days (Section III.4.a). These effluents are, of course, not comparable having different composition fractions of oil, etc. Although it would at first appear that these predicted spills would have no effect on the benthos, there still is a small possibility of an exaggerated impact due to synergistic effects with one or several of the already abundant pollutants. Other impacts on the benthos are expected to be similar to those summarized above in the overview and Santa Barbara Channel portions of this section.

In conclusion, impacts resulting from: 1) Drilling will cause smothering and burial (especially near bottoms firm enough to support an epifaunal community) for a distance of 30 m (100 feet) or greater. Recovery will usually begin within months but biological recovery will not be complete for the epifauna communities for at least 5 years. 2) Pipeline burial will result in community disruption and destruction in the path of the 126 km (7.5 miles) of pipeline corridor construction. Destruction will be minor and will be limited to a diameter of about 30 m (100 feet) along the pipeline path. Recovery should occur in a matter of days or weeks in the more numerous softer bottoms where benthic organisms have mobility abilities. For sessile organisms in kelp beds and harder bottoms, recovery will take from 1 to 2 years (for kelp) to 5 years. 3) Resuspension of polluted sediments will result if pipeline laying or drilling operations occur on the San Pedro shelf. Direct kill to benthic organisms will be of limited but unqualifiable extent and duration. Pesticides could be accumulated in the food chain as the result of drilling in these areas. This could be detrimental to certain individuals at the top of the food chain, although no widespread population fluctuations will result from these operations. 4) A large oil spill with a maximal amount of sinking oil will probably have minor impacts on the subtidal benthos, the extent of which is not

known. Complete destruction of the benthos is not anticipated, but certain extremely sensitive species, particularly microcrustaceans and shallow water endemics, may be eliminated or greatly reduced from the area covered by oil. The impact of spilled oil eventually ending up in the basins is unknown. Natural oil seeps also end up in the basins (California State Lands Commission, 1974) and, although the oils are often of a slightly different composition, spilled oil is not expected to harm the overall community structure although some very sensitive species may be harmed. The impact of a small 500 barrel spill will be negligible, although the impacts from prolonged chronic pollution, such as the 19 expected small (50 to 999 barrels) spills in the Santa Barbara Channel area and the 14.6 in the San Pedro area, is not really known.

ii. Intertidal

Overview. The beaches of the Southern California Borderland include both rocky shores and sandy beaches. Sandy beaches predominate the mainland coast while rocky shores predominate the offshore islands. Very recent work sponsored by BLM and conducted by Littler has indicated there is far less rocky intertidal habitat on the Channel Islands than is shown on Visual No. 2. Exact figures are not available at this time, however.

Most of the information for impacts on intertidal organisms must come from field studies involving actual spills. Few of the fauna and flora typical of the southern California intertidal have been involved in laboratory toxicity studies. The mussel *Mytilus californianus* (Kanter, 1974) is an exception.

Beach fauna suffer a harmful impact from offshore oil spills as is evidenced by the results from several previous accidents. Crude oil from the TORREY CANYON spill reached the beaches, causing mortalities of intertidal and beach fauna. Detergents used to disperse oil complicated an assessment of damage caused by the oil. However, indications were that mortalities were light on beaches where detergents were not employed (North, 1973).

The spill of No. 2 fuel oil in West Falmouth, Massachusetts, from the tanker FLORIDA resulted in a high number of mortalities among intertidal and beach (area above high tide) fauna. This spill eventually covered nearly 3 miles of coastline and resulted in high mortalities (Blumer, et al., 1971). Results from studies of this spill demonstrate that immediate catastrophic and later chronic effects can result from a single oil spill (Sanders, 1973).

North, et al., (1964) reported the effects to the shallow water and intertidal community caused by the TAMPICO MARU oil spill in Baja California. The spill involved approximately 19,000 barrels of diesel fuel initially spilled into a cove having restricted circulation. The intertidal community involved in this spill was nearly identical to those of many intertidal areas of the proposed lease area.

The following summary was taken from Anderson, et al., (1969):

> Immense surf had apparently mixed sand particles with oil films, creating a sludge that rested in depressions and basins on the sea floor. Effects on the fauna were severe. Dead animals were observed wherever natural accumulation of beached debris occurred. Rotting tissue odors were often detectable more than 100 feet from the beach. Species most frequently noted were abalone (*Haliotis cracherodii*, *H. fulgens*, and *H. rufescens*), lobster (*Panulirus interruptus*), pismo clams (*Tivela stultorum*), mussels (*Mytilus californianus*), urchins (*Strongylocentrotus franciscanus*, *S. purpuratus*), and sea

stars (*Pisaster giganteus, P. ochraceus*). Abundances of these dead organisms left no doubt that a most abnormal condition existed. For example, one heap about 300 feet from the wreck contained 69 abalones (all with decaying bodies still in the shell), 5 lobsters, 2 fishes, and a variety of mussels, urchins, crabs, sea stars, and smaller invertebrates. Many similar accumulations occurred along the beach as far away as Punta Cabras, more than 2 miles south of the wreck. Tidepools about 5 miles south still displayed oil films. Populations of the normally submerged snail, *Tegula funebralis*, had emerged from these pools and were clinging to dry rocks around the edge of each pool. At shallow depths near the wreck, large numbers of dead urchins and mussels had accumulated with sludge in basins. The benthos appeared normal at depths greater than 25 feet.

The marine flora appeared to be damaged only slightly, if at all. Two animal species survived. The periwinkle (*Littorina planaxis*), which occupies a position high in the spray zone, (and thus perhaps suffered only slight exposures to oil) generally occurred in close to normal concentrations. A large anemone (*Anthopleura xanthogrammica*) remained in tidepools. This anemone probably tolerates oily substances because the species was noted in the discharge system of an oil refinery using seawater for industrial purposes.

Chan (1972) studied the impact of the San Francisco oil spill which occurred on January 18, 1971, during the early morning hours when two Standard Oil vessels collided almost directly under the Golden Gate Bridge, releasing 840,000 gallons of Bunker C fuel. This asphalt-like oil was washed up on intertidal shores of the area approximately 30 hours after the spill.

From comparative transect and laboratory observations, it was determined that marine organisms died from being smothered by the oil, with certain species, such as acorn barnacles and limpets, suffering the highest mortality. Comparison of pre-oil and post-oil transect counts showed there was a significant decrease in marine life after the oil spill on the reef. Marine snails suffered less mortality than the sessile barnacles and other sedentary animals. The normally large population of striped shore crabs was missing from the rocky crevices. Finally, marine algal blooms, particularly of *Chaetomorpha aerec* and *Enteromorpha intestinalis*, were also observed in certain reef localities.

On a large mussel (*Mytilus californianus*) reef there was only about a 2-percent die-off from unknown causes approximately 2 months after the spill. The species believed to have been killed as a result of the spill are shown on Table III.C.1.b.ii-1.

Table III.C.1.b.ii-1

INTERTIDAL SPECIES KILLED AS A RESULT OF THE SAN FRANCISCO BAY OIL SPILL

Chthamalus dalli	acorn barnacle
Balanus glandula	acorn barnacle
Acmaea spp.	limpets
Pachygrapsus crassipes	striped shore crab
Littorina planaxis	periwinkle
L. scutulata	periwinkle
Pollicipes polymerus	stalked barnacle
Tegula funebralis	(oil may have contributed to a population decrease)
Phyllospadix scouleri	(only slight die-off)

Source: Chan, 1972.

Chan (1975, 1977) reported most invertebrate population numbers had returned to pre-oil spill levels by 1974, most by 1972. Some species, like mussels, had higher population numbers because of the recruitment of young individuals which occupy less space than deceased adults. Only the shore crab *Pachygropsus crassipes* had not returned to pre-spill numbers by 1974 and had low population numbers. By 1976, they had risen significantly over previous counts. Chan (1975) expressed fear that the rare limpet *Littorina planaxis* was on the verge of extinction, but in 1976 was still surviving in low numbers.

From a cleared strip on Duxbury Reef, Chan and Molina (1969) determined it requires 10 years for the population structure of mussels, *Mytilus californianus* to reach the normal population structure with respect to both size and number of individuals.

The communities of the TAMPICO MARU and San Francisco Bay oil spills eventually were repopulated, indicating that oil spills do not permanently damage impacted intertidal areas.

The damage caused by the Santa Barbara oil blowout was not extensive, but was significant at localized heavily-oiled areas to specific organisms, particularly located on the upper intertidal (Foster, et al.,

1971a). Tables III.C.1.b.ii-2 and 3 list the species killed or believed to be damaged during the blowout.

The following are observations made during studies of the Santa Barbara blowout by various authors: 1) the barnacles (*Chthamalus fissus, Balanus glandula, Pollicipes polymerus*), and possibly the mussel *Mytilus californianus* either had a lag in their setting season or had a reduction in the fraction of adults breeding on polluted areas (Straughan, 1971a). 2) Straughan, (ibid) noted that oil does not get a chance to dry out on the lower intertidal where stalked barnacles (*P. polymerus*) reach their greatest abundance. This may cause a greater exposure to toxic chemicals released from the oils through feeding. The greatest destruction occurred, however, on the upper intertidal, especially in tide pools, where oil apparently smothered the shorter *Chthamalus*, but left *Balanus* relatively unharmed because the oil did not completely cover them. 3) Destruction of the intertidal species killed was not permanent because their distribution was broad enough to allow them to repopulate from other breeding areas (ibid). 4) It appeared to Foster, et al., (1971) that the overall damage was definitely related to the initial dose of oil. Had the oil reached shore immediately after the blowout, damage would have been far greater. 5) The leaves of the intertidal surf grass (*Phyllospodix* spp.) were killed because they lack a mucoid covering which is present on the apparently unharmed kelp and other algae (ibid). 6) Cleaning of rocky shores with jets of hot water, not only killed organisms in direct contact with the spray, but caused air-dried oil to liquify and run down to lower intertidal levels where additional organisms were killed (ibid). 7) Cleanup methods were far less destructive than the use of detergents would have been. 8) Foster (1974) believed that many more organisms, on the leaves of surf grass and in intertidal crevices, were killed than were reported. 9) The wavy top shell, (*Astrea undosa*) was reported by Seeley, in Battelle Northwest (1970) as dead or dying on the sand on Carpinteria State Beach. Although covered by oil, they were apparently killed by fresh water. 10) The unusually heavy rainfall of the winter of 1969 unquestionably reduced salinities on the intertidal, complicating impact evaluations. We, however, could find no reported intertidal salinity data for the month of February 1969. The winter of 1973 was another rainy year and Straughan (1973) reported salinities as low as 2 to 6°/oo on the lower intertidal at Ellwood Beach, as low as 24°/oo in the surf of North Carpinteria Beach, and 20°/oo at Ellwood.

To generalize, where organisms have been covered by crude oil and Bunker C fuel oil, death is primarily blamed on smothering due to physical coating (e.g., Chan, 1972; Nicholson and Climberg, 1971). When the pollutant has been a lighter refined fuel oil, mortalities and stress have been primarily associated with toxic effects of the oil (e.g., North, Neushul and Clendenning, 1964).

Table III.C.1.b.ii-2

SPECIES KILLED FROM THE SANTA BARBARA OIL BLOWOUT

Rocky Intertidal Zone	
Barnacles (*Chthamalus*)	
Surf grass (*Phyllospadix* spp.)	
Polychaete worms	
Limpets (*Acmaea paleaces*)	
High intertidal crevice fauna (mostly arthropods)	
Mussels (*Mytilus* spp.)	
Sandy Beaches	
Sandy beach macrofauna	
Euzonus, Emerita, Orchestoidea	
Deep Subtidal Zone	
Benthic Invertebrates	
Neritic Habitat	
Marine Birds	

Table III.C.1.b.ii-3

LIST OF ORGANISMS REPORTED DAMAGED OR FOR WHICH DAMAGE WAS HIGHLY PROBABLE

	Notes
Rocky Intertidal Shore	
Kelp crabs (*Pugettia producta*)	In surf grass
Hermit crabs (*Pagurus* spp.)	
Isopods (*Idotea* spp.)	
Snails (*Lacuna* and *Acteon* (?))	
Barnacles (*Pollicipes*)	Observed damaged by various intertidal investigators
Algae (*Enteromorpha, Ulva, Porphyra, Gigartina, Hesperophycus*)	
All rocky intertidal organisms (including Santa Barbara Harbor)	Affected by clean up activities
Shallow Subtidal Zone	
Subtidal benthic organisms in Santa Barbara Harbor	
Neritic Habitat	
California Sea Lions (*Zalophus californianus*)	

Source: Foster, 1974.

In the event of a major spill beach communities may be expected to suffer considerable localized damage.

Repopulation will begin as soon as the oil clears from the substrate sufficiently to allow setting, but return to pre-spill conditions at completely decimated areas will depend upon the time required to establish a sexually-breeding population of sessile species. In the case of the stalked barnacle, (*Pollicipes polymerus*) the time will be 5 years (Straughan, 1971a).

Newell (1948) and Valentine (1966) suggested that a significant number of endemic molluscs, some with a distribution restricted to 1° latitude, occur within the California Bight. This endemism also occurs in other taxonomic groups (Newman, personal communication, 1974). The implication of this is obvious; severe or chronic alteration of comparable areas of the environment could eliminate endemic species forever. It is conceivable that a large spill could eliminate a sensitive rare endemic with a restricted geographical range from the Bight area. Conversely, extinction may not occur because, 1) intertidal organisms tend to be eurytopic and tolerant to many environmental stresses, and 2) some of the more sensitive endemics may have already been eliminated from other forms of pollution or alterations. The effect of wide-spread chronic oil pollution or a large oil spill in combination with other types of environmental alterations is not known, but could conceivably contribute to the extinction of some of these endemics. Endemics are also discussed above under Benthos in this subsection.

The impact from drilling and pipeline operations on intertidal communities is expected to be slight except at the actual site where a pipeline goes ashore. Here almost complete destruction of the intertidal community in a zone 5 to 10 feet along either side of the pipeline will occur. There is not expected to be any long-term damage to the community. Perhaps the potentially most dangerous impact would be from intertidal sedimentation from polluted sediments stirred up during pipeline laying. The consequence of this, although believed to be minor in relationship to the total of intertidal communities, is not known. This impact is most likely to occur around the San Pedro Shelf area.

Marine vegetation in the intertidal area will be primarily affected by impacts caused by accidental and chronic oil spills and any associated use of chemical dispersants. Other effects could result from turbidity and disruption impacts from pipeline excavation and construction of onshore facilities along the coast.

Marine vegetation includes eelgrass and the attached algae such as kelps, rockweeds, red algae, green algae, and surf grass. The higher the concentrations of low-boiling compounds, unsaturated compounds, aromatics and acids in oil, the more toxic they are to plants (Baker,

1970). Oil deleteriously affects plants by damaging cell membranes, reducing transpiration, often increasing respiration, inhibiting translocation and possibly reducing photosynthesis.

Chan (1975) observed that the surf grass (*Phyllospadix* sp.) and other upper-zoned algae suffered die-offs at the tips of some plants, but that they grew back by one year after the San Francisco tankers spill. Clark, et al., (1975) also noted effects on *Phyllospadix* sp. from oil spilled by a troopship wreck off Cape Flattery, Washington, on January 9, 1972. *Phyllospadix* sp. was heavily oiled and absorbed great quantities of oil. One month after the spill, 41 percent of the dry weight of the plants was oil.

Phyllospadix is a seed plant which occurs in the lower intertidal through the area considered in this EIS. In areas where there is little wave energy, a large spill could cause death of the leaves, but it would require a sustained coverage of several days to kill the entire plant, so regrowth would not occur from the original plant within a few months.

Further impacts of oil pollution on marine vegetation have been summarized by Nelson-Smith (1973). Seaweeds can suffer damage over a considerable area without losing their capacity to recover. The large brown algae of temperate-zone shores are covered with a mucilaginous slime which is not readily penetrated by fresh, thin oil.

Most algae can survive oiling (Smith, 1968), but the small *Hesperophycus harveyanus* became so heavily encrusted around the islands off Santa Barbara that oil-laden plants were broken off by waves which denuded some areas (California Department of Fish and Game, 1969). Some Puerto Rican shores were denuded of algae after the ARGIA PRIMA spill. Diaz-Piferrer (1962) and Spooner (1971) observed similar damage to fucoids overweighted by very thick oil from the ARROW spill in Nova Scotia. The ARROW spill is discussed further in Section III.C.1.h.

Nicholson and Cimberg (1971) compared the flora of Southern California beaches after the 1969 Santa Barbara blowout with surveys made 12 to 15 years earlier and found an average reduction of 63 percent in the number of algal species. Greatest losses were observed to be red algae. However, it is difficult to directly relate the reduction of algae species over that time period to the Santa Barbara blowout. Many other environmental factors and natural fluctuations could have contributed to the reduction. Domestic sewage, collection of specimens or trampling by seashore visitors were also possible causes of the reduction. In an earlier study reported by the Allan Hancock Foundation (1965), Dawson found a reduction in algal species and a change in the dominant species near sewage outfalls of the Los Angeles area.

Red algae also suffered the greatest damage during the TORREY CANYON spill and from the diesel-oil spill around TAMPICO MARU.

Oil pollution can inhibit photosynthetic activity in some algae. However, some species of blue-green algae resist oil pollution and actually thrive under such conditions. Diaz-Piferrer (1962), Spooner (1970), Baker (1971), and Cabioch (1971) recorded blue-green algae around refinery outfalls.

Various species of marine algae have been tested for effects on photosynthesis from Prudhoe Bay crude oil in concentrations of 0.0003-10 ppm, or the expected concentration range from treated tanker ballast-water discharge. Some of the results are reported below as taken from Shiels, et al., (1973):

> Seaweed oil-toxicity experiments, in which the $^{C}14$ method was used to measure photosynthesis, indicated no pattern that was common to all species. Photosynthetic inhibition was indicated for *Cladophora stimpsonii, Ulva fenestrata* and *Laminaria saccharina* at 7 ppm crude oil, whereas other species were not significantly affected at this concentration. Photosynthetic stimulation was noted for several algae at different concentrations (∿80-percent photosynthetic increase by *Ulva* and *Alaria* at 0.7 ppm crude oil; ∿30-percent increase by *Costaria* at 0.007 ppm). *Enteromorpha intestinalis* showed an 80-percent reduction in oxygen production when exposed to 10-12 ppm oil.
>
> The marine plant populations in Port Valdez, Alaska, showed varied photosynthetic responses to crude oil contamination. These responses seemed to result from a complex interaction of several physical, chemical and biological factors that can apparently act in either an adverse or beneficial way.
>
> Seaweed toxicity experiments conducted in this study were limited by the length of exposure time (2 to 4 hours) and the absence of information on the toxic effects of oil to reproductive forms of the algae such as gametes and zoospores. Since the protective covering of mucilage typical of mature plants is often absent in reproductive forms, severe damage to a seaweed population could occur if seawater were polluted by oil during the time of year when gametes are released.

Several genera (*Cladophora, Ulva, Laminaria*, and *Enteromorpha intestinalis*) studied by Shiels, et al., are also found in the area considered in this EIS.

The impact of increased turbidity from pipeline excavation, burial, and dredging on marine vegetation would probably be minimal. A temporary

reduction in sunlight penetration would reduce plant growth and production but long-term growth and production should not be significantly affected. A more adverse effect would be from disruption and removal of habitat from nearshore and onshore pipelaying, and construction of onshore facilities. Damage could be permanent or populations could take up to several growing seasons to recover fully. The extent of this impact would depend on where this activity occurred. Large beds of surf grass in quiet protected areas would be among the most vulnerable habitats.

Artificial substrate and particularly the common hard bottom communities have received some attention in several studies. Communities of animals on artificial substrates are common along the jetties and pilings which protect the entrances to harbors and along the numerous pilings and boat docking structures distributed along the coast. They are also found on oil drilling and producing structures.

Anderson, et al., (1969) reported a 20-percent mortality of barnacles and evidence of recent mortalities among kelp bed pectens on Platform A during the Santa Barbara oil blowout. No other evidence of mortality was noted on the platform.

Although recovery rates of intertidal organisms have been mentioned above in the studies of Chan and others, Littler, Murray, Seapy and coworkers were the first to involve systematic observations of recovery rates and sequence.

In the BLM-sponsored recovery reported by Murray and Littler (1978), small 0.15 m areas were scraped clean of all organisms along transects and observed while the organisms recovered, either by larval settlement, emigration from surrounding areas or regrowth for a period of up to a year. The study is continuing, and some areas, both on the mainland coast and Channel Islands, will have up to 3 years of recovery data. For more detail on this program, see Section II.E.3 and POCS Reference Paper No. III.C.

In general, intertidal macrophytes rapidly reestablished their overall cover percentage on disturbed surfaces, while the macroinvertebrates recovered slowly. In terms of cover, the macrophytes reached pre-harvest levels at 7 of 9 sites, while pre-harvest levels of macroinvertebrates were not attained at any of the stations at the end of a year.

Although macrophytes reached comparable levels of coverage, the populations were not necessarily of the same species distribution nor morphological structures as before. None of the intertidal sites had overall numbers of taxa comparable to those determined prior to harvesting after 12 months. A greater percentage of the numbers of pre-harvest taxa were recorded for the macrophytes (83.1%) than for the macroinvertebrates

(48.8%) after 12 months. Shannon-Weaver diversity and evenness, however, were generally approximated within 3 months for all of the intertidal sites.

Several species of macrophytes, including the articulated coralline alga *Corallina officinalis* var. *chilensis* exhibited remarkable recovery rates. The corallines typically recovered by three months where they formed conspicuous turfs. *Egregia menziesii* showed varying abilities to recover throughout the study areas and did not readily recolonize sites normally subjected to disturbance.

Certain of the mobile animals did recruit juveniles onto the disturbed plots presumably from larval settlement, although colonization was most likely due to the migration of adult animals from surrounding areas. The sessile animals, which were dependent on larval recruitment, typically had slowest recovery patterns. An exception was mainland populations of *Chthamalus fissus/dalli* which recruited heavily onto freshly cleared areas. Generally, it appeared that macroinvertebrate larval recruitment was variable from site to site and species to species.

Several populations of macrophytes and macroinvertebrates were determined to be highly sensitive to disturbance and showed very slow recovery. These included *Pelvetia fastigiata, P. fastigiata f. gracilis, Hesperophycus harveyanus, Phyllospadix torreyi* and *P. scouleri* for the macrophytes. Populations of sessile bivalves, including the mussels *Mytilus californianus, M. edulis, Septifer bifurcatus, Brachidontes adamsianus*, and the clam *Pseudochama exogyra* all revealed virtually negligible recovery after 12 months for the macroinvertebrates. Additionally, the mobile chitons, urchins, and the anemones showed slow recovery during the study.

Several macrophytes occurred conspicuously on the disturbed intertidal quadrats within 3 months. These opportunistic forms were typically algal species with rapid growth rates, high productivity and simple thallus forms with large surface to weight ratios; further, they were characterized by apparently long reproductive seasons and the production of numerous spores. *Ulva* spp. and *Enteromorpha* spp. were found to be among the first colonizers at most sites. Additionally, 3-month plots for the southernmost sites were typically characterized by benthic diatoms, Ectocarpaceae, *Scytosiphon* spp., *Petalonia fascia* and *Colpomenia sinuosa*. The encrusting annelids *Phragmatopoma californica* and *Dodecaceria fewkesi* also appeared to readily colonize disturbed surfaces.

Sandy Beaches. Most pollution studies for the littoral zone are concerned with rocky shorelines of New England and California and their characteristic assemblages of seaweeds, barnacles, limpets, anemones, etc., rather than for sandy beach communities, composed of other invertebrate species which have not been as extensively studied in relation to oil and oil spills.

Trask (1971) studied the effect of oil on sandy beaches during the Santa Barbara oil spill. However, because of a lack of a previous baseline study and because of less sand and, therefore, organisms on many of the beaches during the winter (the time of the spill), he could form no definite conclusions.

By the time the oil reached the beaches, the lighter fractions had evaporated and the oil was too heavy to penetrate into the sand (Straughan, 1972). This, coupled with the low winter community population and sparseness of sand on the beaches, unquestionably prevented greater loss of the beach community.

Foster (1974) reported mortality of the polychaete worm *Euzonus*, the mole crab *Emerita*, and the beach hopper *Orchestoidea* (crustacea, amphipod) during the spill (Table III.C.1.b.ii-2). Chan (1972) reported a sharp reduction of fauna on a sandy beach oiled during the San Francisco Bay oil spill occurred 3 months after the spill. A nearby beach which had not received oil during the spill also experienced a similar reduction, however. The oil spill could not be implicated for the population reduction.

The studies with the intertidal clam *Macoma inquinata* by Anderson and the continued population decrease of the soft shell clam *Mya arenaria* in Nova Scotia have been summarized under Section III.C.1.h.

The literature appears scarce in studies of the meiofauna of sandy intertidal areas. Their large populations on beaches in the Bight was suggested by Parr (Personal communication, 1978). Wormald (1976) reported massive mortality with nearly 100-percent mortality of nematodes and harpacticoid copepods within 4 days on a beach in Hong Kong which had been oiled with heavy machine diesel oil. Populations remained low for 8 months, with nematodes showing a far faster recovery rate than the copepods.

Santa Barbara Channel Area Impacts. The mainland portion of this region extends from approximately Point Arguello to the middle of Santa Monica Bay and includes shoreline segments 27 through 32 of the oil spill model.

Most of this area has a small amount of rocky intertidal. The area from the Palos Verdes Peninsula to Point Dume to the Santa Barbara region has very little rocky shoreline (Visual No. 2). Point Dume is isolated by approximately 56 km (35 miles) to the northwest, 34 km (21 miles) to the southeast, and 51 km (32 miles) from an island having significant rocky intertidal habitat. There are rocky projections and small stacks closer, but during much of the year many of these do not extend to a very low intertidal level before they become buried in sand. Most of the scattered outcrops and stacks are impacted by sand movement, a situation which is not conducive for the survival of many intertidal organisms.

The distance between major rocky intertidal areas could be critical to repopulation should a catastrophic event completely eliminate a species, a portion of the community, or an entire intertidal community. This could be particularly critical if the damage occurred in the lower vertical portions. Larvae of the eliminated species would eventually settle and repopulate the area, but the great distance between the impacted areas and large resources of brood stock probably would cause recovery to be slow. A former community dominant may be replaced by another species with a shorter life cycle which allows it to settle sooner even though it cannot successfully compete with the original dominant. An example of this is the replacement of certain macroinvertebrates by attached macroalgae after an oil spill.

Most of the damage from oil spills, when smothering is the principal cause of mortality, has been to upper intertidal organisms occurring on the numerous small outcrops and stacks but recovery time may be close to normal.

The probability of a spill occurring and reaching the mainland coast within shoreline segments 27 through 32 during the life of the lease is high (Table 5B of POCS Reference Paper VI). The oil spill model predicts when all shoreline segments are combined, a major spill will have a 17 percent probability after three days, a 44 percent probability after 10 days and a 58 percent probability after 30 days of reaching shore. Actually, the shoreline areas could be divided into two sections based on the probability of being oiled. Oil Spill Model Sections 27 and 28 (approximately Port Hueneme to mid-Santa Monica Bay) average 7, 19 and 23 percent probability of impact within 3 days, 10 days and 30 days after the spill while the other segments average only 1, 2 and 3 percent for the same time periods.

The most critical time period to consider is 3 days because at least within Day 1 (not differentiated from 3 days by the oil spill model), there will be many toxic fractions (aromatics) remaining within the oil slick. Day 10 is considered important in this analysis because the oil will have had a chance to spread and hit a larger area, plus this was the time frame involved in the Santa Barbara blowout (see Section III.C.1) which was able to do considerable damage when oil reached shore in heavy concentrations. The 30-day period is considered in most of these analyses more as a safety factor to assure most of the probable impacts will be considered and because the oil spill model is untested with emperical data and could be slightly inaccurate in some cases. The 10-day time period may be the most informative overall since the most probable method of mortality on rocky intertidal areas is by smothering and because, as judged by Santa Barbara, there can still be a lot of oil remaining in the oil slick. The analyses of some of the areas farther offshore with a low probability for impact will be based nearly completely on this 10-day time period.

The expected number of spills of 1,000 barrels or more in the Santa Barbara Channel lease area for the life of the activities resulting from Sale No. 48 is 3.1. This is by far the highest of any area of the proposed sale. The probability of a spill reaching the mainland shore in Sections 27 through 32, given a spill, is surprisingly low according to the oil spill model (Table 2, POCS Reference Paper VI). Essentially nothing will reach shore from tankering or pipeline spills. Only the inner regions (P. 4, 6, 8 and E1, 4 shown in Figures 1-C and 1-D in POCS Reference Paper No. VI) of the proposed and existing lease area will have a 5 percent or greater probability of hitting two or more of the shore segments (27-32) even if the spill were allowed to continue to drift for 30 days.

Sublethal impacts on rocky intertidal organisms from oil coming on shore within one or possibly two days and still containing toxic fractions can include inhibition of spawning and larval settling, general disorientation of some mobile community members, losing attachment ability and being washed away from substrate. These can cause secondary mortalities such as being crushed by surf, being eaten, etc. The largest direct impact from a large 1,000 barrel or greater spill will be from smothering, particularly in the upper intertidal. Some mortality can occur from oil warming and moving into the lower intertidal regions during low tide. Tables III.C.1.b-1 through 3 show the organisms which probably will be impacted. Particularly susceptible to impacts will be acorn barnacles, especially the smaller *Chthamalus dalli/fissus*, limpets *Acmaea* spp, possibly shore crabs *Pachygrapsus crassipes* and eel grass *Phylospadix* spp. Some macrophytes will be damaged or killed by overweighting with heavy oil, e.g., *Hesperophycus harveyanus*. Although less understood, but possibly even more sensitive may be the many small species

occupying crevices in the substrate, within mussel beds or other protective cover. Some of the microcrustaceans (amphipods, isopods, cumaceans, etc.) probably are highly sensitive and may experience massive mortalities.

Our knowledge is not sufficient at the present time to determine if endemic species are among these small species, but it is a strong possibility.

Recovery, although probably somewhat slow because of the isolation of the rocky habitat mentioned above, will occur and eventually be complete. Because of the long breeding season in Southern California, recovery will begin within weeks to many months depending upon the time required for the oil to leave the intertidal surface. The time required for biological recovery will vary greatly with the species, ranging from days to 5 years for gooseneck barnacles. It is unlikely that a spill will cause total mortality of the entire community. Some individuals of all major species will survive all but the most severe spill assuring that there will always be reproducing members of the population even though their numbers are greatly reduced.

The sequence and time to return to the pre-spill population structure will vary with the area and the extent of the mortality. Coal Oil Point, which is covered with oil from natural seeps nearly every day, will probably not require much recovery. Those areas already receiving heavy impact from human alterations or natural perturbations are usually kept in subclimax stages and will not recover this stage anyway.

The sequence of recovery has been outlined above and generally involves colonizing plants having most of their body devoted to photosynthesis rather than to specialized structures. Coraline algae will next predominate mid-tide levels for a period, eventually to be partly replaced as the dominant by the pre-spill dominant species.

The time of recovery to normal population structure will depend upon the vertical level. The upper barnacle zone should require the least time of any of the vertical levels. This can be accomplished in a year. The slowest zone to recover will be the more complex middle and lower levels. The time for these areas to recover will vary from somewhat over a year to up to 10 years in the case of a completely destroyed mussel bed.

Over 90 percent of the Santa Barbara mainland area coast is comprised of sandy beaches and the probability of a spill reaching shore to cover a sandy beach is high. The impact is not expected to be severe, but many of its community members (Table III.C.1.b) could be killed.

Small meiofaunal nematode worms and harpactocoid copepods will suffer some mortality from a large spill but we do not know how extensive. This component of the beach is not well known in California.

Repopulation will begin as soon as the oil is leached from the sediment sufficiently to allow successful resettling by larvae and emigration into the area. The later method will probably be of lesser importance. Because of the fewer toxic fractions in crude oil and high energy of the beaches, the long-term mortalities reported from some of the northeastern areas is not expected to occur.

The situation becomes considerably more optimistic when one considers the accessibility of oil containment equipment. With such equipment on the platforms and the already-operational group Clean Seas serving the Santa Barbara Channel area, nearly all spills will be encountered before reaching shore. The efficiency of the system will significantly decrease the amount of oil reaching shore (see Section III.A.4.b) although during high seas or during a large spill not all oil will be contained.

Because of location, we might be safe in assuming the northern shores of these islands will receive the oil when it reaches shore. The probability of a spill hitting one of these islands over the life of the operations is 65 percent, 95 percent and 108 percent for 3, 10 and 30 days after the spill. The probability of a spill reaching the shores of an island, given there is a spill, is surprisingly high. Nearly all spills originating in the Channel which reach a shore are predicted to hit a Channel Island.

There is about 80 percent rocky intertidal on the northern edges of the Channel Islands according to Visual No. 2. This percentage is probably more accurate than some of the other island areas because of the predominantly steep cliff shoreline of most of the northern shores of the Santa Barbara Channel Islands. One exception is Santa Rosa Island where low cliffs overlook gradually sloping highly productive rocky intertidal areas which are interspersed with sandy beaches.

The impacts summarized above for the mainland coast will also apply in a general way to this area. However, due to the steep topography of these intertidal areas (particularly Anacapa, much of Santa Cruz and San Miguel Islands), the impacts should be somewhat less severe because there will be less stranding of oil on the habitat than on areas with a gradual slope and this will decrease the amount of smothering.

As indicated above, damage from the proposed pipeline crossing the intertidal near Ventura will be relatively minor. Almost complete destruction will occur in a zone 2 m to 3.5 m (5 to 10 feet) along

either side of the pipeline. Since the area has a sandy beach the biota will probably not be affected by turbidity resulting from the activity, nor will the damage inflicted on the intertidal area be long lasting. Somewhat more serious may be the damage to supertidal middle beach plants which would require a longer time to recover.

The use of dispersents would either increase the impact or decrease it depending upon the type used. Recently developed dispersents which are essentially non-toxic and applied offshore so the suspension remains within the water column offshore, will decrease the impacts due to a reduction of oil reaching shore.

San Pedro Bay Area Impacts. This area is composed of shoreline segments 24 through 26 and includes the predominately sandy Santa Monica Bay and the sandy beach stretch between Palos Verdes Peninsula and Newport Beach. The rocky shore Palos Verdes Peninsula is a large island of rocky intertidal between two large stretches of sandy beach. The rocky intertidal areas between Newport and Dana Point are separated from Palos Verdes Peninsula by 32 km (20 miles) tc the north, the rocky intertidal at Oceanside by 64 km (40 miles) to the south and the nearest island, Santa Catalina, by 48 km (30 miles). It appears there are few rocky outcrops or stacks between these rocky intertidal "islands" to supply larvae for setting in the isolated rocky intertidal. See the discussion under the Santa Barbara Channel area in this section for further discussion of this concern for isolated areas.

The oil spill model predicts that when shoreline segments 24 through 26 are combined, a major 1,000 barrel or greater spill will have a 14 percent probability after three days, a 26 percent probability after 10 days and a 39 percent probability after 30 days of reaching these shores. Only one shoreline from the southern half of Santa Monica Bay to the northern half of the Palos Verdes Peninsula (No. 26) has a high degree of probability of being oiled (11 percent, 20 percent and 30 percent for the three time periods). The expected number of spills over the life of the lease is only 0.47 spills for the San Pedro Bay lease area. According to the oil spill model (Table 2, POCS Reference Paper No. VI) the probability of a spill reaching at least two shoreline segments of the mainland from the San Pedro Bay lease area is nearly negligible from the proposed sale. Only one segment (No. 24) has over a 5 percent probability of being oiled. Much the same prediction applies to the existing leases with only the same segment having over a 5 percent probability of being oiled by existing leases.

Littler (1977, 1978) reported the rocky intertidal of these areas are under stress from human activity. His two mainland sites at White's Point and Corona Del Mar were also stressed by sand and rock

movement. This indicates that recovery is a constant occurrence and a subclimax community may predominate much of the area.

The impacts on Santa Catalina and San Clemente Islands, some of which will originate from the San Pedro Bay lease area, will be covered below.

Impacts summarized in the Santa Barbara Island area in this section for both rocky and sandy intertidal areas also apply in a general way to this lease area.

The pipeline proposed to reach shore at Los Angeles-Long Beach Harbor will cross an already severely altered intertidal area and the impact incurred here should be negligible.

Dana Point to San Diego Area. The mainland coast between Dana Point and the Mexican border, shoreline segments 21 through 23, contains only one large rocky intertidal area, the extensive area between La Jolla and San Diego. The rest of the shoreline is primarily sandy beach, similar to the rest of the coastline of Southern California. The data on Baja showing a large stretch of sandy beach south of the border (Figure A-28 POCS Reference Paper No. VI) is somewhat speculative, however, and may not accurately describe the amount of rocky shores.

The oil spill model predicts that when shoreline segments 21 through 23 are combined, a major 1,000 barrel or greater spill will have a 2 percent probability after three days, an 8 percent probability after 10 days and a 16 percent probability after 30 days of reaching these shores.

This low probability reflects the low expected rate of only 0.17 spills over the entire life of the lease. It is notable that nearly all (0.12) of this expected value comes from tankering. No shore section has a high probability of being oiled with all 3 tracts having a less than 10 percent chance of receiving oil even 30 days after the spill. The probability of oil reaching the mainland coast, given that a spill occurs, is relatively high, varying from 27 percent (lease spill point P 19) to 58 percent (lease spill point P 22) and 32 percent and 48 percent for the lower two portions of the tanker routes 10 days after the spill (Figures 1-A & B POCS Reference Paper No. VI). Oil released from the southern portions of these areas have some probability of reaching Mexico.

BLM sponsored research conducted by Littler (Section II.3.a. and POCS Reference Paper III.C) and earlier work by Stephenson and Stephenson (1972) indicate the rocky intertidal is somewhat unique for mainland Southern California due to the substrate type and greater wave energy.

Impacts summarized in the Santa Barbara area in this section for both rocky and sandy intertidal areas also apply in a general way to this lease area.

The oil containment group responsible for oil spills south of Point Dume is SC-PCO which is rather new and less experienced than its counterpart in the north, but will be able to significantly decrease the probability of oil reaching shore in this and the San Pedro Bay area. However, the same precaution in high seas and large spills mentioned in the Santa Barbara Channel area apply here also.

Santa Rosa Area Impacts. The closest land structures to this lease area are the southern or seaward shores of the Northern Channel Islands, San Miguel, Santa Rosa, Santa Cruz, and Anacapa (oil spill model segments 47 through 50). As indicated above, these islands have a near certain probability of being oiled from leasing in the Santa Barbara Channel. From the Santa Rosa area however, only the nearest tanker leg and the northernmost area of the existing lease area (none from the proposed action) have a greater than 5 percent probability of hitting the southern shore of any of these islands (only Santa Rosa and Santa Cruz Islands) within 10 days after a spill, given a spill occurs. The expected number of spills is only 0.06 for Sale No. 48 and 0.10 from all cumulative operations. These two facts indicate that according to the oil spill model, there is a very low probability of a spill from the Santa Rosa area reaching one of the Northern Channel Islands.

Tanner-Cortes Area Impacts. The oil spill model predicts very little probability that a spill from any of the proposed or existing lease areas will hit an intertidal area. This is probably because of the great distance which separates them. Some of the tanker routes in this area have a slight chance (about 10 percent) of reaching San Nicolas or San Clemente Islands. In spite of the expected spill value of 1.14 for Sale No. 48 and nearly 4 (3.67) for cumulative leasing and tankering, it appears the chance of reaching an intertidal area is remote.

Santa Barbara Island Area. According to the oil spill model, Santa Barbara Island will have a very low probability of receiving oil from a spill as the result of Sale No. 48. This is because the expectation of a spill is extremely low, 0.06. The probability of a spill reaching this island, given that a spill occurs, is also surprisingly low; the 10 day values being 12 percent and 16 percent for the proposed areas and 13 percent for the existing tracts.

If a spill hits the island, it has a high likelihood of striking its western shores away from the BLM sampling station. If this happens, however, the extensive intertidal reef off Websters Point may receive heavy oil dosages causing mortality to organisms of this

reef. Much of the reef is at the mid-intertidal level which may cause less mortality than on extensive upper intertidal flats. On the southeastern portion of the island are extensive flat areas where oil may become stranded during lower tidal periods. Most of this community also contains mid-intertidal species (as judged from the BLM sampling station on this island), so exposure will not be as long as on the upper intertidal where most mortality may be expected to occur.

Significant features of this island are the two possibly endemic species. The first is a very abundant and probably important mid-intertidal air-breathing false limpet Siphonaria brananni and the rarer sea Cucumaria pseudocurata found at the low intertidal. Although we do not know the tolerances of these species to oil, we assume the false limpet is quite susceptible because of its direct dependence on air.

San Nicolas Island Area Impacts. The remaining islands will be covered separately rather than within a proposed lease area.

The oil spill model predicts that a major 1,000 barrel or greater spill will have a 6 percent probability after 10 days and a 10 percent probability after 30 days of reaching the shores of San Nicolas Island. Combining these with the existing leases, the probability is increased by only 10 percent.

Much of San Nicolas Island is sandy beach while much of the rocky intertidal is comprised of mostly mid-intertidal levels having little upper intertidal and is stressed by sand movement particularly during the winter. On the northwest tip of the island is an area having many large tide pools. If oil were to remain over these pools for several successive low tidal periods, as is possible in a large spill, extensive mortality would certainly result changing the composition of this unique area for many years.

The Southern Islands Impacts. As indicated in Section II and POCS Reference Paper III.C, Santa Catalina and San Clemente Islands have a southern affiliated flora and fauna. The BLM station on Santa Catalina Island was the richest of all the study areas and the southern shore of San Clemente Island is exceptionally productive and is being examined during the third year of BLM's study.

The oil spill model predicts that the probability of a spill reaching either of the islands within 3 days of a large spill is less than 5 percent. By 10 days Santa Catalina Island has a 13 percent chance of being hit while only after 30 days San Clemente Island has a significant probability (11 percent) of being oiled.

The impacts expected for these island areas is summarized under Santa Barbara Island area of this section.

Baja California Impacts. If one assumes that any segment predicted by the oil spill model as having less than 5 percent change of receiving oil from a spill over the life of the lease as being insignificant, none of the mainland of Baja will be impacted as the result of Sale No. 48. This applies as well to the islands.

Point Conception to Point Reyes Impacts. The oil spill model predicts that as a result of tankering, none of the seashore segments have a significant probability (greater than 5 percent) of receiving oil from a large spill as the result of Sale No. 48. For a discussion of this area, see cumulative impacts below.

Cumulative Impacts. At several areas the oil spill model and expected number of spills data indicate essentially no difference between spill probabilities for Sale No. 48 and cumulative impacts. These will be omitted here.

There is a large difference between the expected number of spills resulting from Sale No. 48 (3.1) in the Santa Barbara lease area compared with the cumulative expected number of 9.63.

The differences between the oil spill model predictions of the combined shoreline segments of Sale No. 48 alone and in combination with existing leases is shown below. The segments (27 and 28) having the highest probability are averaged.

Sections 27-32 - Santa Barbara Channel

	Proposed	Cumulative
3 days	17 %	53 %
Avg. Sec. 27,28	7 %	7.5 %
10 days	44 %	92 %
Avg. Sec. 27,28	18.5 %	32 %
30 days	58 %	139 %
Avg. Sec. 27,28	23 %	51.5 %

It is almost a certainty from the cumulative probabilities that a spill will occur and that one of the shoreline segments will be hit.

The probability of one of the Channel Islands being hit is shown below.

Shoreline Impacts - Channel Islands

	Proposed	Cumulative
	(Shoreline Sections 47, 48, 49, 50)	
3 days	65 %	144 %
10 days	96 %	209 %
30 days	108 %	226 %

The above list points out a significant difference between the proposed and combined activities. The cumulative probabilities indicate that a spill still containing toxic fractions of hydrocarbons will hit one of the Channel Islands. With an expected value of nearly 10, we could have a major spill every two years for the life of the lease. This figure is raised to 29 when the 19 expected small spills of between 50 and 999 barrels are included. Although the effect of these smaller spills are expected to be minor, unfortunate timing of these could not help but aggravate the impact of the larger spills somewhat. The two islands, Santa Cruz and Santa Rosa, having the highest probability of receiving oil have large portions of the rocky intertidal with gradual sloping topography rather than the predominant steep cliff intertidal. If several of these areas received a huge spill every other year for approximately 20 years, we can conclude that these areas would not have a normal reproductively successful community until the year 2005 and would not have a "normal" pre-spill population structure until the year 2010, if by this time a normal climax community could become established. Although the probability would be less, the same thing could occur on the mainland coast. If it were to occur at the isolated Point Dume, the intertidal may never recover. Without knowing the confidence levels of the oil spill model and with all the variables required to make these sequence of events occur, it is impossible to predict the likeliness of this happening, however.

More probably we can expect some long-lasting impacts at a few areas, but recovery should be approximately as outlined in the proposed Sale No. 48 section.

The differences between the oil spill model's prediction of the combined shoreline segments of the Sale No. 48 alone and in combination with existing leases in the San Pedro to Dana Point area are shown below. Most of the probability is the result of a single shoreline segment, number 26.

	Proposed	Cumulative
(Shoreline Sections 24-26 - San Pedro-Dana Point)		
3 days	14%	38%
Sec. #26	11	28
10 days	26	63
Sec. #26	20	47
30 days	39	69
Sec. #26	32	50

The expected number of spills increases greatly to nearly 5 (4.96). If the Alaskan tankering is omitted, the expectation decreases to 3.09.

Unless the 5 expected spills occurring within 10 years and are large and long lasting most of the generalizations summarized under the Santa Barbara Channel in this section will apply to cumulative effects also.

It is interesting that the oil spill model does not predict a greater than 5 percent probability of a spill reaching a shoreline segment of Baja (No. 20) nor one of its islands (Los Coronados Islands) until 30 days after the spill. The probability is low; 8 percent at both areas. The impacts on the primarily sandy beaches of the Baja mainland and the rocky shores of Los Coronados Islands will be similar to those summarized for the Santa Barbara Channel area.

According to the oil spill model the shoreline sections just south of San Francisco Bay (Nos. 42 and 43) have some probability of receiving oil within 10 days after the spill (11 and 8 percent). This coastline consists of approximately equal amounts of rocky shores and sandy beaches. The impacts are not expected to be significantly different from those described above for the Santa Barbara Channel area.

In conclusion, impacts from drilling and pipeline laying will be relatively minor. The damage from oil spills could be severe to the rocky shore intertidal, particularly at small isolated areas. Smothering will cause the principal damage to specific upper intertidal species of plants and animals where all individuals oiled will die. Although the entire intertidal community will not be killed, many individuals of a variety of species will be. Reproduction and repopulation will be retarded for several months, and the

extinction of rare endemics is a possibility. Biological recovery will take up to 5 years, while community stature recovery will take up to 10 years.

The extent of the damage to a sandy beach intertidal community will be less than that to a rocky shore community. The extent of the damage from large spills is unknown but is not expected to be the complete destruction of a community. Cleanup operations of intertidal areas could cause total destruction of the rocky shore communities and significantly harm the communities of the sandy beach areas actually cleaned.

Although it is unlikely, the possibility of long-term damage (even less likely permanent) to the intertidal community of the Santa Barbara Channel resulting from cumulative actions does exist.

The effects of chronic long-term oil pollution on intertidal communities is not known.

c. Impact on Nekton: As defined in Section III.E.4, "nekton" as used in this statement applies to all free-swimming fish and invertebrates occupying the ocean waters. For purposes of continuity when considering impacts of the proposed action on fish, this discussion will also include impacts on fish eggs and/or larvae which follow more of a planktonic life style than that of nekton. A more detailed discussion occurs in Section III.C.1.a. Nekton have an advantage over plankton because of their mobility which, when combined with a sensing ability and natural escape and avoidance behavior, enable them to avoid localized adverse conditions.

i. Impacts on Nekton of the Southern California Bight: As described in Section II.E.4, the environment of nekton in Southern California can be divided into: 1) the mainland and island shelf region (including offshore banks and ridges); 2) the deep-sea basins; and, 3) the general pelagic zone. Offshore development resulting from the proposed lease sale is likely to affect nekton within all three environmental regions.

Temperature, light, currents, food availability and the presence or absence of predators are factors known to affect the distribution of nekton (See Section II.E.4). Therefore, any activity which may affect these factors will most likely affect nekton. Whether such impacts would be widespread or localized would be difficult, if at all possible, to predict at this time.

Santa Barbara Channel Area Impacts. With the modern use of non-explosive energy sources for seismic surveys, the pre-exploratory phase of development should have minimal impact upon the nekton of this area. However, it is possible that TNT may be used in isolated cases to conduct seismic surveys. Falk and Lawrence (1973) report that while explosive sources

killed fish over an extensive area, the non-explosive sources tested caused no direct mortality. In addition, Weaver and Weimbold (1972) reported no harmful effects from non-explosive sources fixed at various depths.

The physical presence of exploratory drilling rigs or vessels along with the discharge of drill muds and cuttings may have a temporary and localized effect on the nekton of the area. The attraction of nektonic organisms, especially fish, to floating and submerged structures is a common occurrence and since drilling rigs are well lighted, this attraction may be enhanced at night.

Observations in the Gulf of Mexico indicate that fish are also attracted to the drill cuttings as they cascade down through the water column where they may be sampled as food items and rejected. No definitive bioassays have yet been conducted with drill muds and nekton species found in the area of the proposed operations to identify possible toxic components.

The field development phase of the proposed action will most likely involve the installation of about 10 platforms within the Santa Barbara Channel area (see Section III.A). Development wells will be drilled from these platforms and, like exploration rigs, drilling muds and cuttings will be discharged into the sea. The function of oil drilling platforms as artificial reef structures is a widely recognized occurrence and has been documented within the Santa Barbara area. The platforms will attract nekton almost immediately and, due to their semi-permanent nature, will act as artificial reefs with the establishment of a diverse community (Carlisle, Turner and Ebert, 1964). Discharged drill cuttings will form low mounds on the bottom within the immediate vicinity of the platform and may subsequently be mixed with the underlying sediment or colonized by benthic organisms (Zinguler, 1975). As mentioned previously, the effects of drill muds on nekton of the area have yet to be conclusively established. In addition to platforms, subsea completions may be placed on the sea floor. Such structures would most likely function like platforms and provide an artificial reef structure attractive to fish and other nekton.

During the production phase of offshore operations, the structures have already been installed and nekton may be affected through the disposal of formation waters which contain the soluble components of crude oil and trace amounts of certain heavy metals. Such discharges would increase from none during the early phases of field development and production to over 5 million bbl/yr within the Santa Barbara Channel (see Section III.A). The Southern California Coastal Water Research Project (SCCWRP) has examined several of the various heavy metal components of formation waters on marine organisms (including nekton) of the Southern California area. However, analysis of the entire spectrum of formation water components and the effects of chronic discharges upon the fish and nekton

of Southern California have not been done. It should be noted, however, that due to the magnitude of dilution, the process of microbial degradation, and the chronic low-level natural oil seepage already occurring within the Santa Barbara area (as well as throughout Southern California generally) overall adverse effects upon nekton are expected to be moderate at most as a result of the proposed action. Those impacts which do occur would be expected to be localized within the area of a platform and would affect those nekton which frequent the structures.

The transportation phase in the Santa Barbara area is expected to involve primarily pipelines, although tanker traffic will also occur here. Temporary, localized increases in suspended sediment will occur as the pipe is being layed and is not expected to significantly affect the nekton of the area. Tanker transportation of oil produced in all of the areas involved in the proposed action will occur through the Santa Barbara Channel. At least one major oil spill (1,000 bbl's or greater) could occur during the life of the proposed action from platforms alone. When the transportation phase is added to this, the expected number of spills in the Santa Barbara Channel area increase to 3.1 (see POCS Reference Paper No. VI).

Little information is available on the effect of spilled oil on members of the nekton other than fish. Hufford (1971) cited several early studies which show that crude and bunker oils harmed or killed fish eggs in laboratory experiments. Mironov (1968, 1969, 1972) has found concentrations of crude oil in water at about 1 ppm to adversely affect the eggs of turbot, anchovy, scorpianfish, and sea parrots of the Black Sea. Struhsaker and others (1974) found development of abnormal embryos to be the principal effect of benzene, a water soluble component of crude oil, on eggs of Pacific herring (*Clupea pallas*) and anchovy (*Engraulis mordax*). More recent experiments exposing female Pacific herring to low (ppb) levels of benzene for 48 hours just prior to spawning resulted in a significant reduction (as much as 50 percent) in survival of eggs, embryos and larvae through yolk absorption when compared to control mortality levels (Struhsaker, 1977). Similar results have been observed on Starry flounder using concentrations as low as 100 ppb although they do not appear as acute as for herring (Dr. Jean Struhsaker {now Whipple}, personal communication). These experiments have yet to be completed. Results of ichthyoplankton studies conducted during the ARGO MERCHANT spill indicate that as many as 93 percent of pollack eggs and 64 percent of cod eggs within the immediate vicinity of the spill were contaminated by oil. This was apparently the first report of oil adhering to fish eggs, either from the vicinity of a spill, or in laboratory experimentations. No oil was reported to have adhered to fish eggs following the Santa Barbara spill nor has oil been found adhering to eggs during any of the recent CalCOFI surveys (Dr. Reubin Lasker, personal communication). Ebeling, et al., (1971) could find no significant affect on fishes following the Santa Barbara spill, although there was a temporary disappearance

of mysid shrimp from kelp canopies. Bottom fish communities appeared normal and pelagic fish spottings showed no apparent changes in abundance of mackerel, northern anchovies, or bonito following the spill (Straughan, 1971).

In a review of the effects of oil on developing fish embryos, Longwell (1977) noted that 50 to 90 percent of the pilchard, *Sardina pilchardus*, eggs found in the vicinity of the TORREY CANYON spill were reported to be dead and juvenile forms were scarce or abnormal. He goes on to state that this could have been due to the toxic effects of the emulsifier used to disperse the spill, to the oil itself, or to other unknown factors. Such conclusions point out the fact that conclusive experiments demonstrating the effects of dispersing agents as well as oil itself have yet to be completed.

San Pedro Bay Area Impacts. Many of the impacts upon nekton in this area would be the same as those just described for the Santa Barbara area. Transportation of oil produced in this area is expected to be by pipeline to shore, however, any advantages this may provide will be offset by increased tanker traffic within the area. Therefore, a major oil spill would cause the greatest threat to nekton. In any event, the overall impact upon nekton of this area due to the proposed action is expected to be relatively insignificant.

Dana Point-San Diego Area Impacts. Many of the impacts upon nekton expected during various phases of development have been described for the Santa Barbara area. Although the types of impacts may be similar, the severity upon nekton would be greater due to the relative lack of existing oil "pollution" from natural seeps and boat traffic as occurs in the previous two areas described. Nektonic organisms within the same or similar species groups as those found in areas of high "natural" oil occurrences (e.g., Santa Barbara Channel) may be far more sensitive to the effects of oil than their "oiled" counterparts. Because of the active swimming habits of nekton, however, it is expected that major spill areas (considered the greatest threat to nekton) would be avoided or at least the nekton would quickly recover. Because of the non-resident nature of many of the nektonic species of this area those detrimental impacts which do occur may be only temporary.

Santa Rosa Area Impacts. The impacts upon nekton of this area would be the same as those described for the Santa Barbara area. The severity of these impacts, however, may be somewhat greater because of the general lack of human activity (i.e., platforms, vessel traffic, etc.), presently in the area.

Tanner-Cortes Area Impacts. Basic impacts on nektonic organisms of this area due to the proposed action would be the same as those described for the Santa Barbara area. However, because these banks are so far removed

from shore and because they seem to represent a pristine environment the nekton of this area could stand to receive the greatest impacts of all areas within the Bight. The most serious impacts are expected as a result of oil spills. However, as mentioned, these would be for a short period of time. More serious or long-term impacts may result from numerous small spills or chronic pollution. Unfortunately, little information is available to predict these impacts.

Santa Barbara Island Area Impacts. See the discussion for the Santa Barbara Channel area.

ii. Baja California Impacts: No development will occur off Baja nor is oil transportation (tankering) expected. Therefore, the only impacts on marine nekton would occur as a result of a major oil spill being driven by wind and currents from more northern areas. The oil spill risk model (POCS Reference Paper No. VI) predicts that most spills within the Bight area will be driven south, although few will impact shore. Even with this, the greatest impacts to nekton would occur within the first few days after a spill. It is generally accepted that most of the volatile components of crude oil harmful to fish and other nekton dissipate within the first hours or at most a couple of days after a spill.

iii. Tankering Leg Impacts (Point Conception to Point Reyes): Impacts on nekton of this area will result only from a major spill due to a tanker catastrophy. Such an impact, although severe, would be short-term with affected nekton avoiding the area or quickly repopulating from surrounding areas. Probably the greatest effects on nekton will result from the use of chemical dispersants which would spread the oil throughout the upper surface of the water column. Two areas which are significant in terms of nekton and may suffer severe although temporary impacts, are the Monterey Bay area and the Gulf of the Favallones (just outside the Golden Gate at San Francisco). Because of its significance as a "staging" area for King salmon migrating up the Sacramento River to spawn, a major tanker accident outside the Golden Gate in the late summer or fall months could have severe and long-range impacts on a major component of the nekton off Central and Northern California.

iv. Cumulative Impacts: The cumulative effects of oil spills, chronic discharges, construction turbulence, and drilling fluid discharges would possibly have the most drastic negative impacts on resident nekton, like rockfish and bottom fish (flatfish). The effect would probably be greatest on the offshore resident nekton since they are exposed to all the stresses from platforms, pipelines, tankers and barges whereas the inshore resident nekton would be primarily affected by stresses associated with pipelines and a limited amount of tankering from the Ventura and/or Los Angeles-Long Beach areas.

The cumulative effects of the proposed lease sale, existing leases and an increase in transportation activities associated with these and other (Alaskan) OCS development combined, would probably be of greater significance to nektonic organisms than from the proposed development alone. The expected number of spills (1,000 bbl or more) over the life of this proposal increases from 5 to as many as 19 when both proposed and existing leases along with mixed pipelines and tanker transportation are considered (see Section III.A). The possibilities of a major catastrophic event (such as a spill) occurring are, therefore, greatly increased. Impacts on nekton resulting from such an event are likely to be relatively short-term and insignificant considering the impact of the Santa Barbara spill. Probably of greater significance are the increases in chronic low-level pollution due to discharges from drilling structures and/or tankers. Although such impacts are difficult to predict at this time, it is likely that there will be some. Whether they effect nekton significantly, will only be determined with close monitoring.

v. Summary of Impacts on Nekton: The pre-exploratory phase of development will have minimal, if any, impact upon the nekton of the area.

The temporary and semi-permanent structures placed during the exploration and development phases will attract nekton almost immediately, acting as artificial reefs. A diverse community can be expected to become established on the longer term structures. The effects of drill muds discharged from such structures have yet to be conclusively established. The same is true for the effects of formation waters. However, due to the magnitude of dilution, no overall adverse effects resulting from formation water discharges (at the presently accepted limits set by the EPA) upon nekton are expected.

The greatest adverse impacts upon nekton could result from a major spill. Although historical evidence suggests the possibility that significant impacts to nekton may result from the application of dispersing agents, experiments providing an adequate understanding of the effects of modern materials and application techniques have yet to be completed.

Conclusions. The greatest adverse impacts on nekton resulting from the proposed action would result from oil spills and/or chronic discharges and would have the greatest effects (overall) on resident nekton. Overall effects of the proposed lease sale on nekton are expected to be minimal at most. Structures, in fact, may have a beneficial impact in their function as artificial reefs, although these benefits are expected to have an overall minor impact on nekton.

d. Impact on Pelagic Birds

i. Introduction: This section describes the major impacts on pelagic birds from the proposed action and the major cumulative impacts from related actions in the study area. Most impacts on pelagic birds would take place in the Southern California Bight around the proposed lease areas. According to the most probable development scenario in Section I, the Santa Barbara Channel would have the most resource potential and development activity, followed by the Tanner-Cortes Banks area and the San Pedro Bay area. Outside the Southern California Bight, projected oil spills from the proposed action could impact pelagic bird populations off Baja and central California.

This section considers impacts over the projected life of the proposed development, or 25 years. Most probable development and impact scenarios to the year 2000 for the proposed action described in Section I and III.A were used to analyze the major impacts. The oil spill model results described in Section III.A and POCS Reference Paper No. VI were also considered. Section II.E.1 and POCS Reference Paper No. I describe the pelagic bird populations in the study area. Section III.E.3, Impacts on Shorebirds and Coastal Birds, also analyzes the impacts on seabird nesting and roosting areas.

The impact analysis starts with a brief description of the major impact types from the proposed action, continues with an area-by-area analysis of the major impacts from the proposed action on the pelagic birds and concludes with a brief summary of the major cumulative impacts for related actions for each area.

ii. Impact Types: As a result of the proposed action, impacts on the pelagic bird populations could occur from acute and chronic oil spills, increased human disturbance and habitat loss, and the potential for increased contamination of the ecosystem and the birds' food supply. Toxic and sublethal effects from oil spills could cause the most significant impacts on pelagic seabird populations.

The following overview of the major impacts on seabirds from OCS development is taken from University of California, Santa Cruz (1978) with minor changes and additions. The detrimental impacts on seabird populations from OCS development could have one or more of the following effects:

(a) depression of reproductive output,

(b) increased mortality,

(c) decreased availability of food or greater energetic costs of obtaining food,

(d) preemption of critical habitats, and

(e) reduction in species diversity by removal of a member-species from the animal community.

Populations vary in their ability to withstand or recover from detrimental impact. This resilience is largely a function of two factors:

(a) size and insularity, and

(b) reproductive status at the time of impact.

There are other factors affecting resilience to impact that are difficult to describe and perhaps impossible to define. These factors seem to be related to the behavior, ecology, distribution and movements of individual species. Basically, it is not known what levels of impact a population may withstand before irreparable damage is done, or, in other words, what population level constitutes a biologically viable critical mass. Certain factors must be kept in mind when assessing the long-term impacts on pelagic seabird populations:

(a) there may be far-reaching consequences of impact,

(b) the effects of impact may be cumulative, and

(c) not only are there species differences in vulnerability, there are species differences in the ability to recover.

Potential Hazards and Their Sources. Each phase of OCS resource development carries with it several sources of potential detrimental impact (hazards) to seabird populations (Table III.C.1.d-1). Since OCS resource development activities have both at-sea and onshore components and typically span from one to several decades, there exist, in addition to obvious and immediate episodic events (such as wellhead blowouts), chronic, low-intensity impacts. The cumulative effect of chronic, low-intensity impacts (such as seepage, boat traffic, etc.), may be as significant over time as the impact of short-term, high-intensity events (such as oil spills). Further, there exist more subtle ecosystem effects that may profoundly alter the animals' supporting biological medium. At present, there are no unequivocal data demonstrating adverse effects of small amounts of oil in ecosystems. However, long-term studies have yet to be undertaken. Therefore, these impacts are still unknown.

The Effects of Oil on Marine Birds. Essentially, there are three types of hazards that can result from OCS oil resource development:

(a) Floating Oil - oil on water or beaches can lead to fouling of feathers, ingestion through preening or grooming, inhalation, and irritation of eyes and nictitating membranes;

Table III.C.1.d-1

SOURCES OF POTENTIAL HAZARDS TO SEABIRDS RESULTING FROM OFFSHORE OIL RESOURCE DEVELOPMENT AND PRODUCTION

Activity or Facility	Chronic Hazards	Episodic/Catastrophic Events
Exploration		
Seismic profiling	Noise, "startle" effects	Sub-surface noise - Concussion
Drilling		Siltation
Boat traffic	Propeller hits	Downstream pluming Opacity increases
Operation		
Onshore facilities Staging areas Pumping stations Tank farms Separation Plants Refineries	Disturbance near reproductive areas of sensitive bird populations (depends on site) Introduction of terrestrial predators	Disturbance in construction
Offshore facilities Production platforms		
Well-head	Leakage/seeping	Blow-out
Support Crew and supply boats	Sub-surface noise and propeller hits	
Aircraft	Noise in air	
Transport		
Pipelines	Leakage	Rupture
Pumping buoys	Leakage	
Barges and tankers	Bilge oil	Collision or grounding
Cleanup		
Oil on water		Boat activity
Skimmers		
Burn-off		Pollution--air
Chemicals		Pollution--water
Grounded oil		
Booms Straw Chemicals		Disturbance to sensitive bird populations on islands by human intrusion and aircraft activity

Source: University of California, Santa Cruz (1978).

(b) Increased Human Activity and Disturbance - increased boat or aircraft traffic at sea and increased human activities on the islands can lead to disruption of reproductive, feeding, and migratory activity at sea and disturbance to the fragile social order in bird reproductive colonies;

(c) Ecosystem Contamination - contamination of water by pollutants that may lead to the preemption of critical feeding grounds, decrease the suitability of food resources, or decrease the abundance of prey species through ecosystem effects of unknown magnitude.

Our knowledge of the mechanisms whereby pollution of ecosystems, disturbance, and floating oil damage populations of birds varies from group to group and with the nature of the impact. Since seabirds are both conspicuous along populated coastlines and relatively vulnerable to oiling, much public attention and some scientific research has been focused on oil/seabird interactions. Therefore, some of the major acute impacts from oil spills can be identified. The following three sections summarize the available information on the three hazard types listed above.

(a) Floating Oil. Contact with floating oil affects marine birds in four obvious ways: by fouling of feathers, by ingestion, by inhalation, and by irritation of eyes and nictitating membranes. When oil contaminates feathers, two important physiological changes occur: bouyancy decreases and normal thermal resistance is impaired. Of the two, destruction of the insulation properties of the body covering is probably more damaging.

Most of the immediate mortality of birds that come into contact with spilled oil is due to contamination of the feathers. Severe oiling of the plumage leads to mechanical inability to fly or to forage under water, and lowering of body temperature (hypothermia) by impairment of the normal thermal resistance to cool environmental temperatures afforded by the plumage. Hartung (1967) found that oil on the plumage of waterbirds results in heat loss proportional to surface area oiled and that death in oiled birds usually comes after fat reserves are exhausted. Since oiled birds usually refrain from eating, Hartung concluded that starvation, accelerated by rapid use of fat reserves for thermal maintenance, was often the cause of death.

Birds may take in oil during grooming or preening of contaminated feathers. There have been few studies of the physiological effects of oil ingestion in these animals, although blistering and hemorrhaging of the alimentary tract has been demonstrated. Further, laboratory experiments by Hartung (1965) and Grau, et al. (1977), have shown that oil ingestion causes cessation of laying and reduced hatchability in some birds. A recent study by Miller, Peahall, and Kinter (1978) reported

that herring gull chicks given single 0.2ml doses of kuwait or south Louisiana crude oil suffered growth inhibition, interference with plasma osmoregulation, and hypertrophy of hepatic, adrenal, and nasal gland tissues. The authors concluded that these multiple sublethal effects of oil ingestion on birds could reduce long-term survival chances for affected species. There has been no serious study of the physiological effects of inhalation of petroleum or its volatile constituents by seabirds.

A number of factors influence the vulnerability of different species of birds to contact with spilled oil. Factors which increase vulnerability include: 1) tendency to form large, dense flocks on the water; 2) existence of a species only as small populations; 3) considerable time spent swimming on the water; and 4) tendency to dive (thus being recontaminated upon surfacing) when alarmed. On the other hand, a species which has the following characteristics is likely to be less vulnerable to spilled oil: 1) foraging done by widely-dispersed individuals; 2) foraging accomplished by plunge-diving from the air or foraging done onshore; and 3) a tendency to fly rather than dive when alarmed.

To some extent, all colonial seabirds are vulnerable to contact with floating oil during the nesting season, since they are concentrated near their colonies during that period. However, species such as cormorants and alcids are particularly sensitive as they possess several characteristics which act to increase exposure to spilled oil. In Southern California, brown pelican populations could be vulnerable due to their restricted distribution and small population size, while western gulls could be expected to be affected by spilled oil to a lesser extent.

Generally, seabirds believed to be the most susceptible to contamination by oil are: murres, guillemots, auklets, murrelets, puffins, loons, grebes, and scoters. Shearwaters, fulmars, albatrosses, petrels, gulls, terns, shorebirds and some ducks and geese are also vulnerable to contamination at sea, but less so than divers. Table III.C.1.d-2 lists historical seabird mortalities from oil spills.

Damage caused to seabirds by oil pollution is often obscure because it is difficult to detect when birds are lost from more distant populations and because the effect may be widely spread and difficult to distinguish from other causes of mortality (Bourne, 1970). The affinities between wintering and breeding areas and migration routes for most populations of seabirds are mostly either unknown or based on speculation. Better information is available for some populations of waterfowl because of extensive bandings and relatively high recovery rates of bands for some species.

Table III.C.1.d-2 is a presentation of selected oil spills incidents and the resulting seabird mortality. The figures given in Table III.C.1.d-2 for the 1969 Santa Barbara spill is considered as a low estimate because

Table III.C.1.d-2

SEABIRD MORTALITY FROM OIL SPILLS

Date, Place	Estimated No. Killed	Dominant Species	Estimated Population Loss
1971-Northern Scotland[d]	2,000-10,000	Murres	10%
1969-Netherlands[g]	35,000	Eiders	
1969-Santa Barbara[b]	3,686[a]	grebes, loons	
1971-San Francisco[h]	20,000	grebes	
1969-Irish Sea[g]	4,400	Murres	70-80%
1967-Cornwall[f]	40,000-100,000	Murres razorbills	
1953-Baltic Sea[e]	10,000	eiders, mergansers, scoters	
1955-Elbe River[e]	500,000	scoters	
1937-San Francisco[c]	6,600	murres	
1966-East England[i]	5,000	gulls, dunlins	
1976-Chesapeake Bay[j]	10,000-31,000	grebes, oldsquaw ducks	
1977-New England Coast[k] (ARGO MERCHANT)	540	murres	
1969-Findland[l]	2,400-3,000	Eiders	25-33%
1966-Danish Archipelago[m]	22,000	scoters	
1956-California[n]	2,900	scoters	
1972-Denmark[o]	30,000-40,000	Eiders	
1975-California[p]	5,000	Murres	

Source: Williams and McGrew (1977).

[a]Birds observed. Figure is not a total estimate of birds killed.
[b]From California Department of Fish and Game, 1969b.
[c]From Moffitt and Orr, 1938.
[d]From Bourne and Johnston, 1971.
[e]From Goethe, 1968.
[f]From Bourne, Parrack, Potts, 1967.
[g]From Bourne and Bibby, 1975.
[h]From Smail, Ainley, And Strang, 1972.
[i]From Harrison and Harrison, 1967.
[j]From Commonwealth of Virginia, 1976.
[k]From U.S. General Accounting Office, 1977.
[l]From Soikkeli and Fritanen. Aqua Fenn. 1972.
[m]From Bound. Seabird Bull. 1969.
[n]From Richardson. Murelet Vol. 37. 1956.
[o]From Joensan. Reprint from Marine Pollution Bull. 4(8); 117-118. 1973.
[p]From Berkner and Smail. Personal correspondence. 1978.

it is based on beach counts of oiled birds. Such counts are low for several reasons. Scavenging foxes and gulls quickly remove some carcasses and others are either tossed high upon the shore or buried in sand. Circumstantial evidence suggests that from 50 to 91 percent of the birds killed at sea may never wash ashore (Jones, et al., 1970; Tanis and Marzer Bruyns, 1968), but, rather, they sink or are eaten by gulls and fish. Additionally, birds may either die some distance from the site of oiling or, as later discussed, they may be reproductively impaired. A reliable estimate is that birds observed killed from a spill represent about 10 percent of the total number actually killed (Nelson-Smith, 1973).

Straughan (1971) discussed the loss of birds as a result of the Santa Barbara oil blowout in January, 1969. The California Department of Fish and Game conducted aerial and beach surveys of 2,784 square km (1,075 square miles) of affected area between February 5 and March 31, 1969. They estimated a population of 12,000 birds for the study area and observed no unusual movements of birds during this period. A second survey was carried out between April 1 and May 31, 1969. The estimated population at this time was 85,000 resulting from significant influxes of pelagic species.

Beach transects were established along 9.17 km (5.7 miles) of beach area, of which 7.72 km (4.8 miles) was oil-contaminated. A daily average of 439 birds were observed, 290 of these being within the oil-contaminated area. A total of 70 dead birds were recorded in the transect area. On the basis of the transect data, bird losses for the 121.82 km (75.7 miles) of beach from Point Conception to the mouth of the Ventura River were estimated to be 1,603. Added to this were 1,388 which died after treatment, 175 turned into the treatment stations dead, and 439 reported from other sources outside the study area. As of May 31, 1969, known bird losses totaled 3,686. This total did not include the unknown number of birds lost on the open water which failed to drift ashore.

Rehabilitation of Oiled Birds. Aldrich (1970) reviewed the problem of rehabilitation of oiled birds and reached the following conclusions:

(1) Oil of varying sorts can be cleaned from the plumage of birds with several kinds of cleaners, but so far there is no convincing evidence that the natural water-repelling qualities can be restored to the cleaned feathers by known means. The only cases where birds cleaned of oil have apparently been successfully returned to the wild are those in which the birds had been held in captivity through the annual molt.

(2) Curing oiled birds of the original toxic effects of ingested oil and of the ills developing from rehabilitation is basic to the success of any salvage effort and must be perfected for each species concerned.

(3) Aside from the special pathological problems resulting from the initial poisoning and exposure, soiling of the feathers by oil, and the problem of restoring waterproofing to the plumage, the problems involved in the care of cleaned oiled birds are largely avicultural. Their difficulty depends on the reactions of different species of birds to captive conditions and the knowledge of the aviculturist about the requirements of any one species in captivity.

So much uncertainty surrounded the estimates of success in "rehabilitating" birds from the TORREY CANYON disaster that Clark and Kennedy (1971) restricted their evaluation of the treatments up to the time of release, even though this gave an "over-optimistic" view of the situation. Treatment methods were generally unsuccessful, with only 450 of at least 7,848 oiled birds for which records were maintained surviving one month following treatment, for an initial survival rate of 5.7 percent. Bourne (1970) calculated that only 0.2-0.4 percent were soon found dead under conditions where the recovery rate was poor. He concluded that it was unlikely that the rehabilitation rate reached 0.25 percent, and it could well have been much less.

The small numbers of oiled birds surviving the rehabilitation efforts following the collision of the ARIZONA STANDARD with the OREGON STANDARD in San Francisco Bay in 1971 suggests that little progress has been made with methods since the TORREY CANYON spills in 1967. Of the estimated 7,000 birds that were brought to cleaning stations in mid-January, 1971, some 200 were still alive in late May and over 50 had been released (Wallace, 1971), with only from a fifth to a quarter of those being treated surviving more than 10 days (Lassen, 1971). Many of the birds brought to the cleaning stations were dead upon arrival.

Research in cleaning and husbandry techniques by the International Bird Rescue Research Center, J.T. Naviaux, the Research Unit on the Rehabilitation of Oiled Seabirds, P.B. Stanton, and C. Swennen since 1971 has led to the development of a technology that has increased release rates to above 50 percent in many instances and lowered the time spent in captivity to an average of one week.

(b) Increased Human Activity and Disturbance. Acceleration of offshore petroleum resource development necessitates increases in ship and aircraft traffic near offshore facilities and between those facilities and the shoreline. The probability of intrusion upon land areas used by animals for reproduction is also increased.

It is not known how ship or aircraft noise affects birds in or above water. The seabirds found in the Southern California Bight (SCB) are not known to hunt acoustically, though this possibility should not be overlooked.

Disturbance of bird colonies on land is a more tangible and well-known hazard. Disturbance is much more than an inconvenience to these animals--their reproductive activities may be completely disrupted by

human intrusion or aircraft flyovers at critical times. Seabirds react to man by deserting their nests. Human intrusion on nesting areas can lead to crushing of eggs, collapse of underground burrows, and mortality of eggs and chicks due to inter-specific predation. Reproductive rookeries are used traditionally by seabirds and repopulation following disturbance may, in some cases, require decades.

A severe impact on seabird populations could result from disturbance or intrusion upon seabird nesting colonies in the breeding season. Any attempt to clean up these areas in the event of an oil spill would likely cause more harm to the animals than the presence of oil on land.

(c) Ecosystem Contamination. There is much evidence that the productivity of colonially-breeding animals is limited by the availability of food. The likelihood that food availability plays a major role in regulating populations of island-dwelling seabirds is particularly strong. The location of colonies of seabirds is closely tied to location of foraging areas; even small changes in the abundance of prey, time required for foraging, or nutritional suitability of prey can cause major alterations in reproductive ecology.

The same can be said of important traditional migration routes. Over evolutionary time, migrating birds have been selected to use routes offering the optimal feeding areas, lowest mortality rates, and ease of passage. A loss of an important feeding area along such a route might well be very detrimental to a population as a whole.

No one really knows how spilled oil or its metabolites, drill muds, or trace metal pollutants affect marine food chains or whether environmental alterations due to offshore oil production can preempt or spoil a major feeding area. This is not to say that such effects do not exist, but rather that long-term food chain experiments have yet to be conducted.

Efforts at oil spill treatment and cleanup have damaged bird populations in the past. Frequently the emulsifiers used were more toxic than the oil itself and may have been transferred to birds which came to eat fish and invertebrates killed in the treatment area (Aldrich, 1970). The new generation of dispersants, while supposed to be no more toxic than the oil by itself, have not really been evaluated in its effect on birds, so the effect is unknown. The dispersants do drive the oil into the water column and prevent the oiling of birds. The effect of new mitigation and cleanup materials and methods will have to be reevaluated when used in the proximity of birds in the future.

University of California, Santa Cruz (1978) has identified certain red flag species listed in Table III.C.1.d-3 that are known to be vulnerable to the types of impacts normally associated with OCS development. These species may have a very limited ability to recover from detrimental impact. Table III.C.1.d-4 lists categories of areas of special sensitivity to bird populations mapped in Figure III.C.1.d-1. The significance of each area is described in Table III.C.1.d-5. These areas include critical nesting areas, feeding grounds, and traditional migrating pathways.

Table III.C.1.d-3

RED FLAG SEABIRD SPECIES

(Seabird species most vulnerable to impacts related to OCS oil resource exploitation. All populations are considered vulnerable to disruption of feeding grounds wherever they aggregate in large numbers. Birds are protected under the Migratory Bird Treaty Act.)

Species	Comments
Migratory waterfowl, loons, grebes	Most are divers and are very susceptible to oiling of feathers; many species forage in large groups in restricted areas of shallow water nearshore.
Cormorants	Breeders in Channel Islands; very susceptible to disturbance of colonies; roost ashore in large groups and forage in flocks.
Brown Pelican	Endangered species and Channel Islands breeder; very susceptible to disturbance of colonies; susceptible to oiling of feathers.
Phalaropes	Very numerous and wide-ranging but susceptible to oiling of feathers.
Western Gull	Channel Islands breeder; may contaminate eggs by bringing oil to nests on breast feathers.
Nesting Alcids (Cassin's Auklet, Pigeon Guillemot, Xantus' Murrelet)	Very susceptible to oiling of feathers; gather in large groups near colonies; vulnerable to disturbance of colonies and introduction of terrestrial predators.
Wintering Alcids	Very susceptible to oiling of feathers; may concentrate in restricted offshore areas for feeding.

Source: University of California, Santa Cruz (1978).

Table III.C.1.d-4

AREAS OF SPECIAL SENSITIVITY

(Areas of special sensitivity to impacts related to OCS oil resource development identified during the 1975-76 survey are shown in Figure III.C.1.d-1 and described in Table III.C.1.d-5.)

Areas are grouped according to three categories:

Category A: Highest Biological Significance

These areas are of greatest importance to animals because one or more of the following conditions are met:

(1) year-round heavy use;

(2) predictable seasonal concentrations of major proportions;

(3) locations of bird nesting areas or pinniped rookeries;

(4) presence of especially vulnerable species.

Oil and/or disturbance in these areas constitutes an extreme threat to animal populations. The probability of catastrophic impact--that measure of impact affecting entire populations in the Southern California Bight and from which recovery is uncertain--is great because many animals are concentrated in one place and/or young may be present.

Category B: Higher Biological Significance

These are the preferred open-water habitats of marine mammals and birds. They are used consistently by several species as feeding grounds. Oil and/or disturbance in these areas constitutes a substantial threat to animal populations. The concentration of the animals are not like those in Category A but are relatively widespread and mobile.

Category C: High Biological Significance

These are areas known for seasonal use either as foraging grounds or migration pathways. Oil and/or disturbance in these areas constitutes a moderate threat to animal populations. The probability of catastrophic impact is not as great because these areas receive only seasonal use.

It is important to realize that marine mammals and birds use all the island and water resources of the SCB. Only areas of extraordinary significance to the animals are listed in Table III.C.1.d-5.

Source: University of California, Santa Cruz (1978).

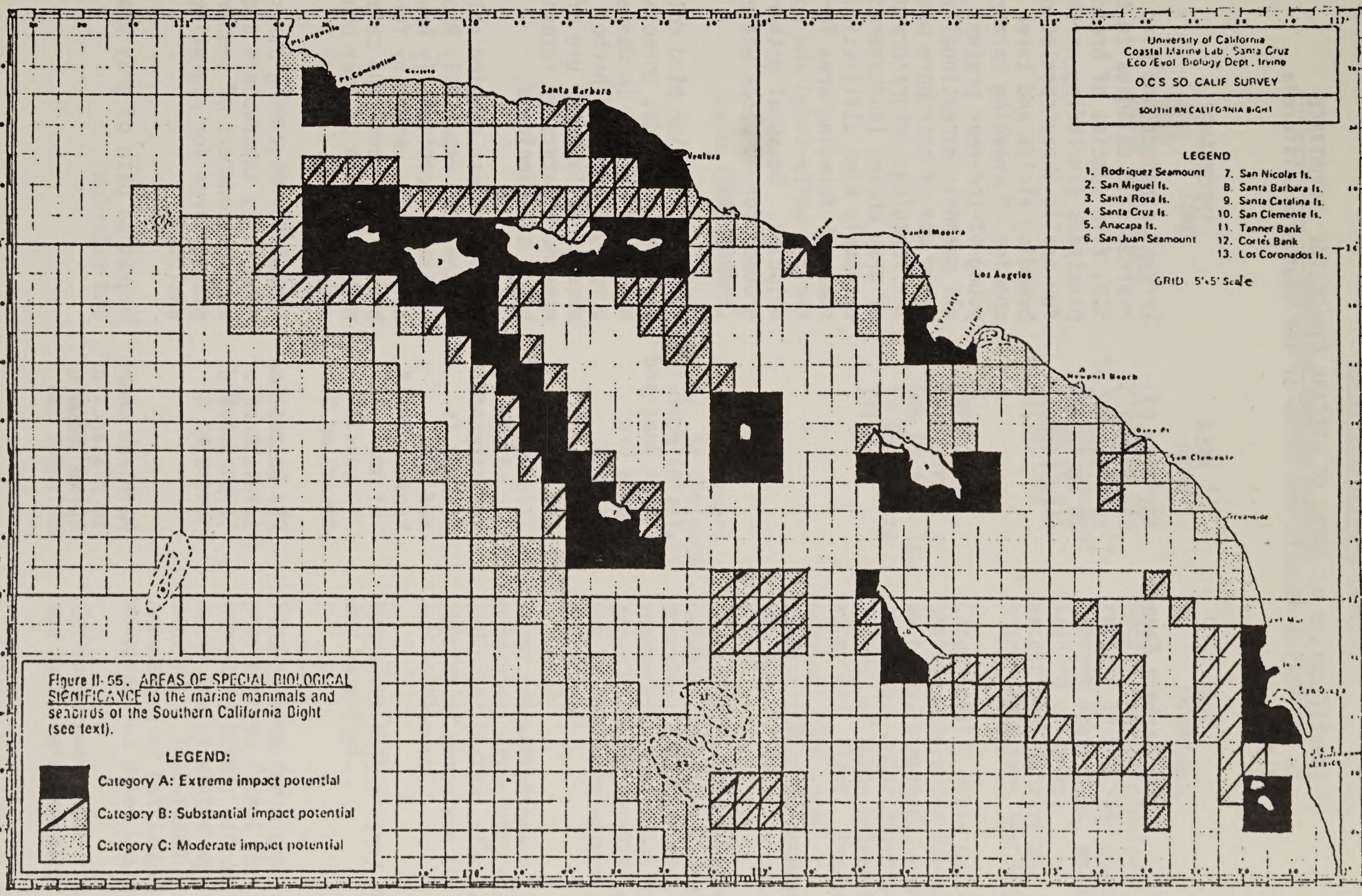


Figure III.C.1.d-1 Areas of Special Biological Significance to the Marine Mammals and Seabirds of the Southern California Bight

Source: University of California, Santa Cruz (1978)

Table III.C.1.d-5

Identification of AREAS OF SPECIAL BIOLOGICAL IMPORTANCE to the Marine Mammals and Birds of the Southern California Bight.

ZONE	AREA	IMPORTANCE
Santa Barbara Channel	Vicinity of San Miguel Is. to distance of 20 km in all directions	Largest pinniped and bird reproductive colonies in the SCB; five species of breeding pinnipeds (including northern fur seal); three species of breeding alcids and three species of breeding cormorants; young-of-the-year present in all seasons; exceptionally heavy use of nearshore waters for foraging: migratory path of gray whales (endangered), extremely high utilization as seasonal foraging area for Pacific white-sided and common dolphins. Seasonal gathering grounds for humpback whales (endangered).
	Vicinity of Santa Rosa and Santa Cruz islands	Presence of major bird colonies, especially alcids, cormorants, and Brown Pelican (endangered); pupping grounds of harbor seals; exceptionally heavy use of nearshore waters by foraging birds and pinnipeds.
	Vicinity of Anacapa Is. and the Ventura Shelf	Second largest seabird colony in the SCB, especially Brown Pelican; exceptionally heavy use of these waters by foraging birds, pinnipeds, and cetaceans; migratory path of gray whales and waterfowl.
	Pt. Conception to distance of 10 km seaward	Funnel for migrating birds, especially shearwaters and Brant; enormous numbers of seabirds; staging area for migrating gray whales
	Mainland shore to distance of 10 km seaward	Migration path of gray whales and waterfowl.

Table III.C.1.d-5 (Cont.)

AREAS OF SPECIAL BIOLOGICAL IMPORTANCE

ZONE	AREA	IMPORTANCE
Santa Rosa Ridge	Vicinity of San Nicolas Is. to distance of 10 km in all directions	Second largest pinniped rookery in the SCB; pups present year-round; major seabird colonies; exceptionally heavy use of nearshore waters for foraging.
	Santa Rosa Ridge from San Nicolas Is. to Santa Rosa Island	Exceptionally heavy use of shallow waters for foraging by birds, pinnipeds, and cetaceans; major migratory pathway of large baleen whales along west flank. Area of greatest open water concentrations of cetacea in the SCB.
Santa Cruz Basin	Santa Barbara Is. to distance of 20 km in all directions	Large and diverse seabird colonies, especially Xantus' Murrelet; important pinniped rookeries and seasonal hauling grounds; exceptionally heavy use of nearshore waters for foraging.
	Eastern sill of Santa Cruz Basin	Major concentrations of cetaceans, especially minke and pilot whales, plus several species of porpoises (Dall's and bottlenose).
	Pt. Dume to distance of 10 km seaward	Migration path of gray whales and waterfowl.
Santa Monica Basin	Vicinity of Pt. Vicente to distance of 10 km seaward	Staging area for migrating gray whales; funnel for migrating birds; extremely heavy use by wintering seabirds. Year-round population of bottlenose dolphins and pilot whales.
	Santa Monica Bay shoreline	Extremely heavy year-round use by foraging seabirds.

Table III.C.1.d-5 (Cont.)

AREAS OF SPECIAL BIOLOGICAL IMPORTANCE

ZONE	AREA	IMPORTANCE
San Pedro Basin	Vicinity of Santa Catalina Is. to distance of 10 km in all directions	Major feeding grounds for cetaceans, migration path and milling grounds of gray whales. Area of maximum seasonal concentrations of pilot whales in SCB; harbor seal pupping in spring. Major flyway for loons and Brant.
	San Pedro Channel	Corridor of movement for bottlenose dolphins and pilot whales between mainland and Santa Catalina Island.
	Mainland to distance of 10 km seaward	Migration path of gray whales and waterfowl.
San Diego Basin	Vicinity of Pt. Loma	Staging area for migrating gray whales; very large concentrations of wintering waterfowl.
	Mainland shore to 10 km seaward	Migration pathway of gray whales and waterfowl. Heavy seasonal concentrations of common dolphins in vicinity of Dana Pt.
	Coronado Escarpment	Important pinniped and bird colonies on nearby Los Coronados (Mexico), especially Brown Pelican, extensive use of escarpment waters by massive schools of foraging small cetaceans, especially common dolphins; birds, especially Brown Pelicans; and pinnipeds.
San Clemente Ridge	Vicinity of San Clemente Is. to distance of 10 km in all directions	Sea lion rookery on the west side; important seabird roost at north end, especially Brown Pelican.

Table III.C.1.d-5 (Cont.)

AREAS OF SPECIAL BIOLOGICAL IMPORTANCE

ZONE	AREA	IMPORTANCE
San Clemente Ridge (continued)	San Clemente Escarpment	Seasonally important foraging ground for small cetaceans, California sea lions, northern elephant seals, and petrels.
Tanner-Cortés Banks	North rim of the San Nicolas Basin	Major foraging grounds for migrating birds, sea lions, and several species of cetaceans.
	Tanner and Cortés Banks	Moderate to heavy year-round use as a foraging ground for sea lions, migrant and wintering seabirds, and several species of cetaceans.
Oceanic Zone	No specific areas of use; however, these waters are occupied by migrant northern fur seals in winter and spring; major offshore corridor for migration of large whales (blue, sperm, fin, sei, and humpback--all endangered).	

Source: University of California, Santa Cruz (1978).

Santa Barbara Channel. This area has the highest projected oil and gas resource potential for this proposed sale. Turbidity and toxic effects from drill cuttings, drilling muds, sewage waste, and formation water discharges and pipeline burial should have a low impact on pelagic seabirds and seabird prey species in the Santa Barbara Channel as a result of development from this proposed lease sale. Generally, any effects would be maximum during the production phase with peak production occurring about 8 years after the sale. Muds and cuttings discharge would stop by 10 years after the proposed sale when all exploratory and development wells would be completed. Formation water discharge would be greater during the last years of production while sewage waste discharges would remain at a fairly constant rate of 20,000 gallons per day total for the 10 projected platforms by 8 years after the proposed sale.

Disturbance effects to seabird populations should be low from placement of 10 platforms and laying 402 km (250 miles) of pipeline in the production and transportation phases. Disturbance effects from boat and aircraft traffic servicing the platforms, the projected 1 offshore storage and treating facility, and the 30 subsea completions are also expected to be low. Any impacts would be greatest during the winter months and in May when the largest numbers of seabirds are present in the Channel. The areas of greatest potential impacts would be in leases around Point Conception, leases directly north of the northern Channel Islands, and leases in the northeastern corner of the Channel (see Figure III.C.1.d-1).

Acute chronic oil spills and cleanup activities would have the most impact on pelagic seabirds of all impacts considered from this proposed action, as discussed previously. The oil spill model predicts that 3.1 spills greater than 1,000 bbl and 6.05 spills from 50 to 1,000 bbl would occur in the Channel during development from this proposed sale over the projected 25-year life of the fields. The greatest number of spills would occur during the transportation phase from projected pipeline and tanker spills (see Section III.A.4 and POCS Reference Paper No. VI). From the oil spill trajectory probability tables in POCS Reference Paper No. VI, spills from proposed leases, tanker routes, and pipeline corridors in the Channel would most likely hit the southern part of the Channel around the northern Channel islands. This is an area of extreme impact potential for seabird populations as mapped in Figure III.C.1.d-1 and described in Table III.C.1.d-5. Therefore, large spills that hit this area could have a significant impact on seabird resources, especially during January through June when seabird densities are very high along the island shelves.

If a major spill occurred in proposed leases or transportation corridors in the eastern part of the Channel during October through March, it could impact the dense concentrations of seabirds along the mainland shelf and

north of Santa Cruz Island (see Figures III.C.1.d-4 and 5). This area has also been designated an area of extreme impact potential for seabirds by the University of California, Santa Cruz (1978). Therefore, impacts from major oil spills on bird populations in this area could be significant. Likewise, the area off Point Conception is also an extreme impact potential area for bird resources and receives especially heavy migratory bird use during July through September. Major oil spills hitting this area have the potential to cause significant impacts on seabirds.

The oil spill model predicts a less than 42 percent chance of 1 spill greater than 1,000 bbl hitting any of the most dense pelagic seabird conentrations in the Santa Barbara Channel within 60 days from any of the proposed lease areas. The most likely number of spills greater than 1,000 bbl occurring and contacting the highest pelagic seabird concentrations is zero. However, since seabirds heavily use all parts of the Channel at various times throughout the year, the 3.1 spills greater than 1,000 bbl predicted by the spill model for the Channel could impact some seabird populations throughout the year. The significance of the effects is difficult to determine since the highest seabird concentrations change by season and geographic area in the Channel. Generally, spills hitting the three heavy use areas of the Channel discussed above would receive the greatest impacts.

With the two large surface current gyres in the Channel, oil spills would probably remain in the open ocean for some time. After 3 days of evaporation and dispersion, most toxic fractions would be greatly diminished. Generally, within 48 hours of a spill, 40 to 60 percent of the spill would evaporate (Slack, Wyant, and Lanfear, 1978). Within 10 days, most of the spill could be cleaned up or contained, if conditions are favorable. If non-toxic dispersants were used, the oil could be kept in the upper 3 to 4 m (9.9 to 13.2) of the water column for a longer time period. Based on past data from the Santa Barbara blowout, if one of the 3.1 spills greater than 1,000 bbl were the size of the Santa Barbara spill of 1969, about 3,700 grebes and loons could be killed from the spill.

The long-term, chronic impacts on pelagic seabird populations from major and minor spills projected over the 25-year production life of this proposed sale are unknown.

<u>San Pedro Bay</u>. This area has the third highest projected resource value for this proposed sale. Oil production would peak at 7 years after the proposed sale, or in 1986. The impacts on the pelagic seabird populations and prey from discharges and pipeline burial would be similar to the Santa Barbara Channel, except at a lower magnitude. Muds and cuttings discharge would end by 11 years after the proposed sale and formation water discharge would be greatest during the last years of production. Sewage waste discharge would remain at a fairly constant 6,000 gallons per day rate after 1986 for the 3 projected offshore platforms.

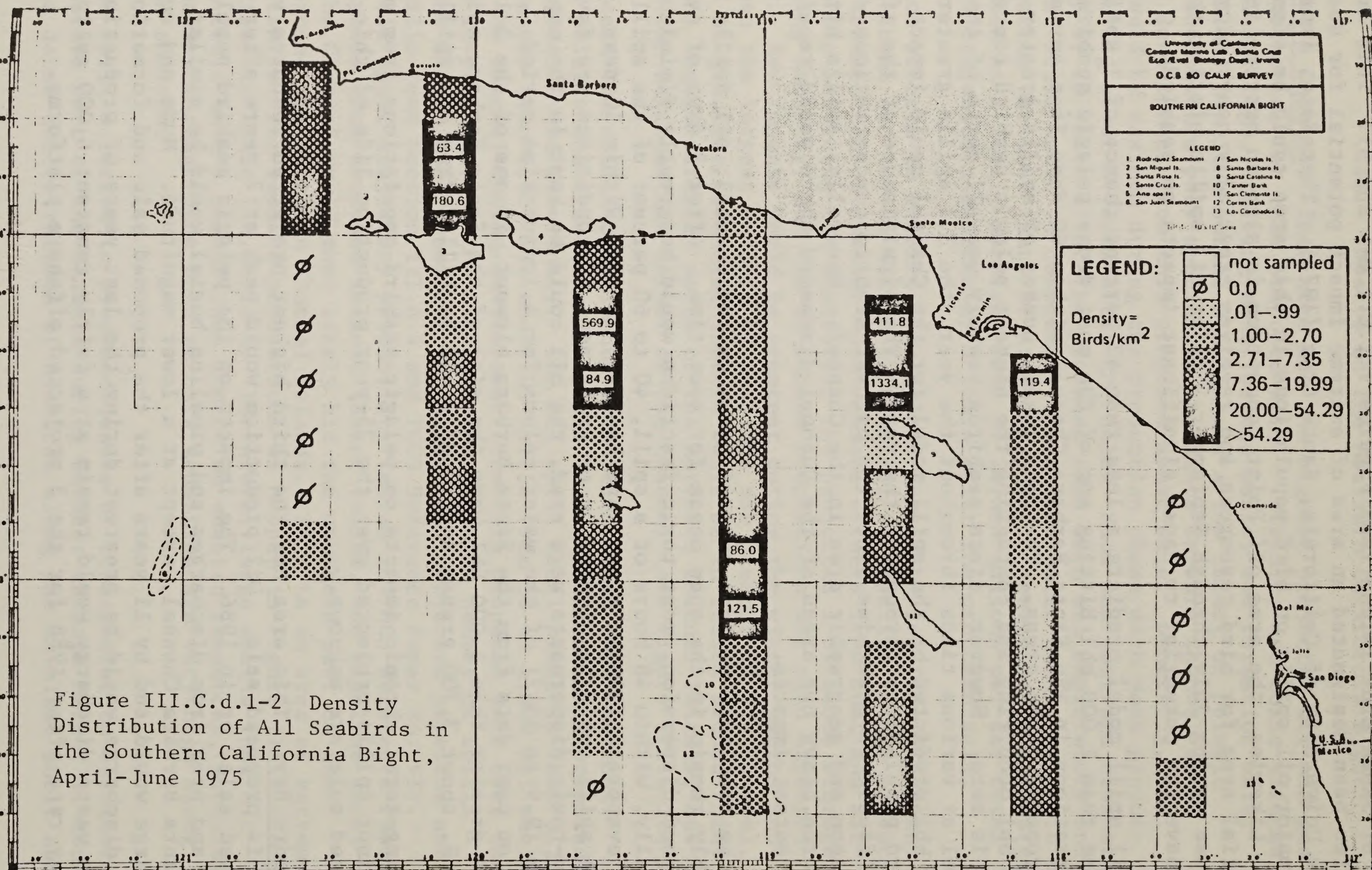


Figure III.C.d.1-2 Density Distribution of All Seabirds in the Southern California Bight, April-June 1975

Source: University of California, Santa Cruz (1978)

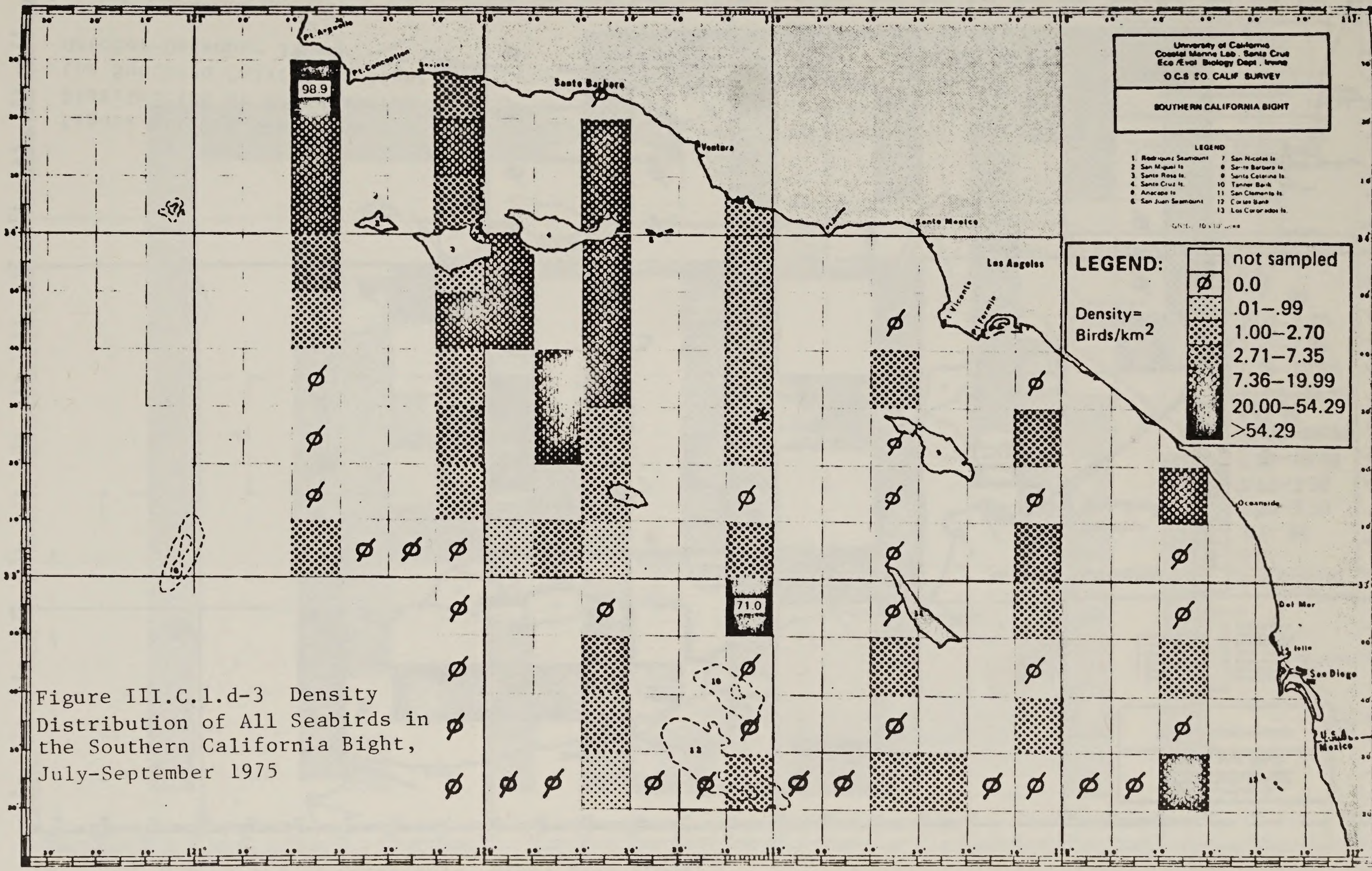


Figure III.C.1.d-3 Density Distribution of All Seabirds in the Southern California Bight, July-September 1975

Source: University of California, Santa Cruz (1978)

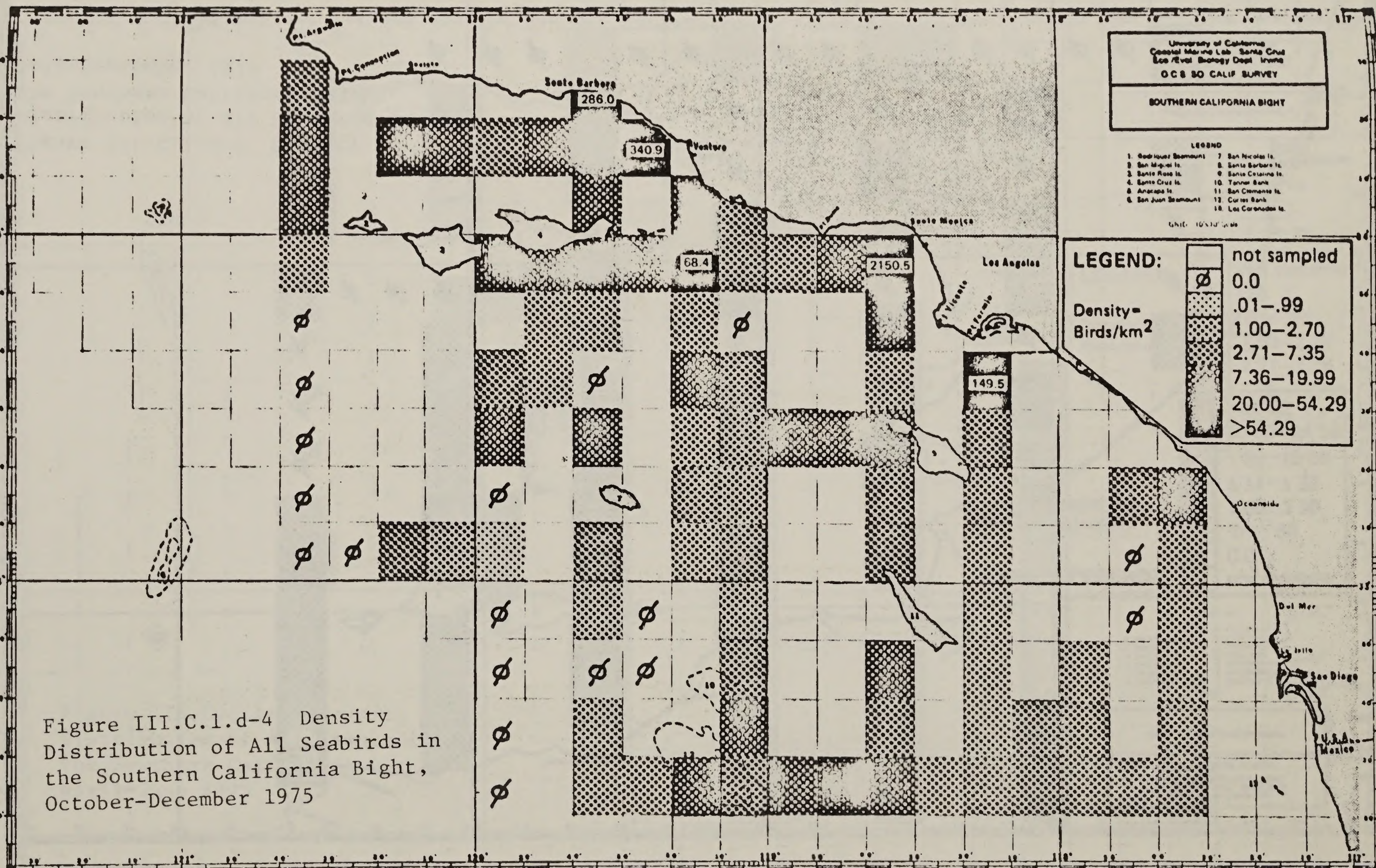


Figure III.C.1.d-4 Density Distribution of All Seabirds in the Southern California Bight, October-December 1975

Source: University of California, Santa Cruz (1978)

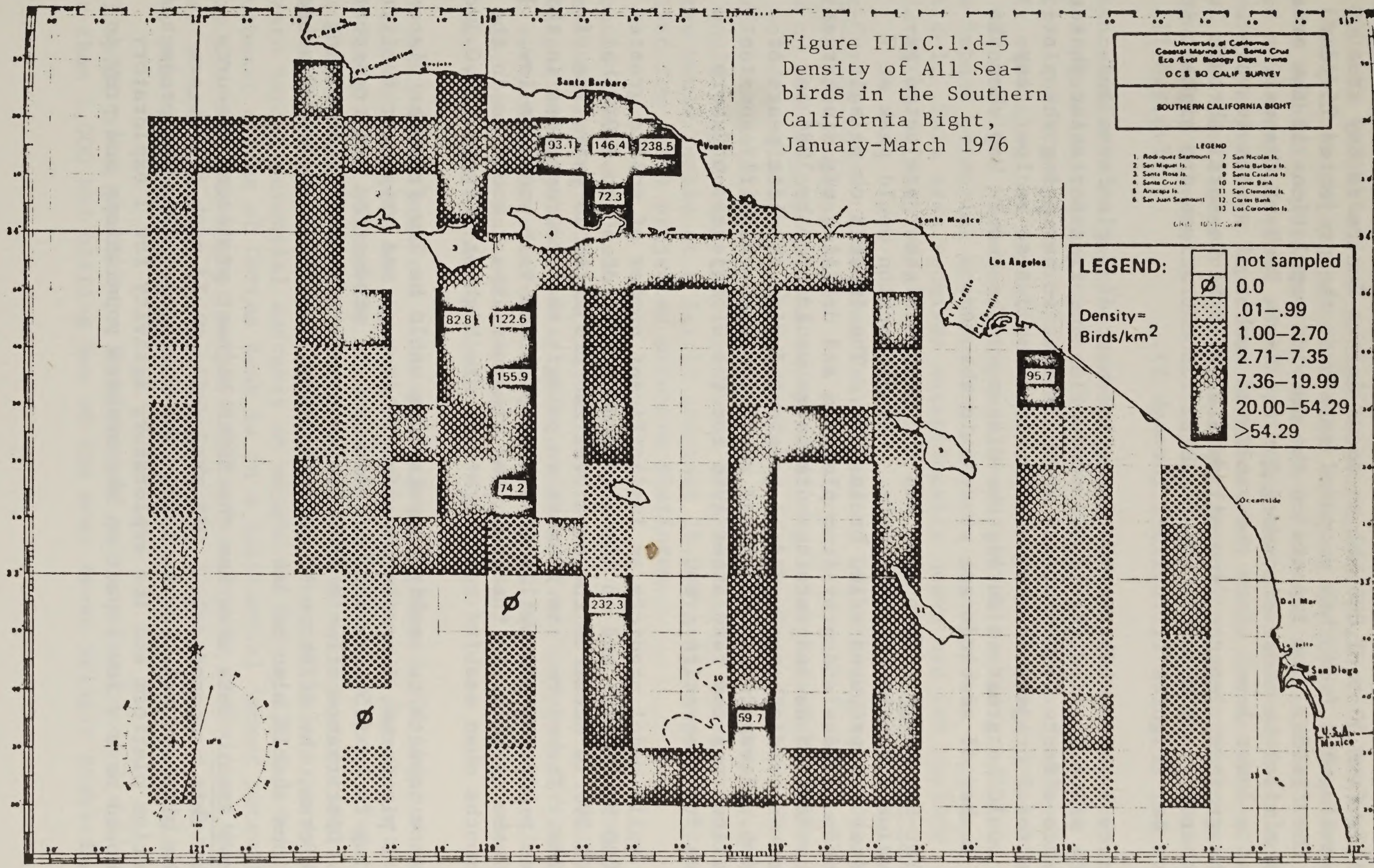


Figure III.C.1.d-5
Density of All Sea-
birds in the Southern
California Bight,
January-March 1976

Source: University of California, Santa Cruz (1978)

The oil spill model predicts only 0.47 spills greater than 1,000 bbl and 1.38 spills from 50 to 1,000 bbl to occur in the San Pedro Bay area during development from this proposed sale over the projected 25-year life of the fields. The impacts on the seabird populations in the area would be similar to those discussed for the Santa Barbara Channel, except at a lower level since the predicted number of spills is very low. The greatest impacts from oil spills would be in April through June and October through December when seabird concentrations are highest in San Pedro Bay (Figures III.C.1.3-2 through 5).

Disturbance impacts would be low from placement of 3 platforms and laying 64 miles of pipeline in the production and transportation phases. Disturbance effects from boat and aircraft traffic servicing the platform and the 7 projected subsea completions would also be low. Any impacts would be greatest during the winter months and in May when the largest number of seabirds are present in the Bay.

Dana Point-San Diego. This area has the fourth highest projected resource value for this proposed sale. Oil production would peak at 7 years after the proposed sale, or in 1986. The impacts on pelagic seabird populations and prey from platform and drilling rig discharges should be low. Muds and cuttings discharge would stop by 1988 and formation water discharge would be greatest during the last years of production. Sewage waste discharge would remain at a fairly constant 6,000 gallons per day rate after 1986 for the 3 projected offshore platforms for the entire area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.17) and an insignificant number of 50 to 1,000 bbl spills (0.29) to occur in the area over the projected 25-year life of the fields. Therefore, the impacts on pelagic seabird resources in this area from predicted oil spills from this proposed sale would be low. If a spill were to occur in the area, the greatest impact would be in the winter months when seabird concentrations are highest (Figure III.C.1.d-5).

Disturbance impacts to seabird populations would be low from the placement of 3 platforms, 1 projected offshore storage and treatment facility, and laying 24 km (15 miles) of pipeline in the production and transportation phases. Disturbance effects from boat and aircraft traffic servicing the platforms, the offshore storage facility, and the 3 projected subsea completions should also be low.

Santa Rosa Area. This area has the fifth highest projected resource value for this proposed sale. Oil production would peak at 7 years after the proposed sale, or in 1986. The discharges from the projected 1 production platform and the exploratory activity for 3 exploratory wells should have a low impact on the seabird populations and prey in the area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.17) over the projected 25-year life of the field. Therefore, impacts on seabird populations in this area from oil spills from this proposed sale would be low. Spills hitting the area in the winter months would have the greatest impact on seabirds when their concentrations are highest. The Santa Rosa ridge is in an extreme impact potential area as designated by University of California, Santa Cruz (1978). (See Figure III.C.1.d-1).

Disturbance effects on pelagic seabird populations would be low from placing 1 platform and laying 96.6 km (60 miles) of pipeline in the production and transportation phases. Disturbance effects from boat and aircraft servicing the 1 platform and the 2 projected subsea completions should also be low. However, proposed leases in this area are in an extreme impact potential area for and seabirds as mapped in Figure III.C.1.d-1. This area receives exceptionally heavy use for shallow water foraging by seabirds.

Tannner-Cortes Area. This area has the second highest projected resource value for this proposed sale. Oil production would peak in 1986. The impacts on seabird populations and prey from discharges and pipeline burial would be similar to those discussed for the Santa Barbara Channel. Muds and cuttings discharge would stop by 1990 and formation water discharge would peak during the last years of production. Sewage waste discharge would remain at a fairly constant 18,000 gallons per day rate after 1986 for the 9 projected offshore platforms.

Distrubance impacts to seabird populations would be low from placing 9 platforms and laying 405.5 km (252 miles) of pipeline in the production and transportation phases. Distrubance effects from boat and aircraft traffic servicing the platforms and the projected 28 subsea completions should also be low. Any effects would be greatest in the winter months and in May when the seabird numbers are highest.

The oil spill model predicts 1.14 spills greater than 1,000 bbl and 3.17 spills from 50 to 1,000 bbl from this proposed sale over the projected 25-year field life. Since the predominant wind direction and surface current flow in the area is to the southeast, most spills occurring in the area would be carried south and southeast. Most of this area is in a moderate impact potential category as mapped in Figure III.C.1.d-1. The southeast corner of Cortes Bank is in a substantial impact potential category since it has higher seabird concentrations in the winter than the rest of the Banks area. The Tanner-Cortes Banks area is a moderate to heavy year-round foraging ground for migrant and wintering seabirds.

The oil spill model predicts a less than 42 percent chance of 1 spill greater than 1,000 bbl hitting any of the most dense pelagic seabird

populations in the area in 60 days from proposed leases. The most likely number of spills greater than 1,100 bbl occurring and contacting the highest pelagic seabird concentration in the area is zero.

The long-term, chronic impacts on pelagic seabird populations from major and minor spills projected over the 25-year production life of this proposed sale are unknown.

Santa Barbara Island Area. This area has the lowest projected resource value for the proposed sale. Production would peak in 1986. Discharges from the projected 1 platform and the exploratory activity for 2 exploratory wells would have a low impact on the seabird populations and prey in the area.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.09) over the projected 25-year life of the field. Therefore, impacts on pelagic seabird populations in this area from oil spills from the proposed action would be low.

If a spill does occur in the area, the impact could be significant since the proposed leases are in an extreme impact potential area as mapped in Figure III.C.1.d-1. The large and diverse seabird colonies in the area are the third largest in the Southern California Bight and include a colony of Xantus' murrelets. This colony is vulnerable because of its small size and its isolation from the parent population. Seabirds, including the Xantus' murrelet, make exceptionally heavy use of the nearshore waters for foraging.

Disturbance impacts to seabird populations would be low from placing 1 platform and 1 offshore storage and treatment facility. Disturbance effects from boat and aircraft traffic servicing the platforms and the projected 1 subsea completion should also be low.

iv. Baja California Impacts: The only impacts on pelagic seabird populations off Baja California from this proposed sale would be from oil spills from proposed lease areas drifting down with the southeasterly-flowing California Current. Any spills reaching the waters off Baja would be greatly weathered with most toxic fractions dissolved. The greatest number of potential spills from the southernmost lease areas is 1.14 predicted from the Tanner-Cortes area and 0.17 predicted from the Dana Point-San Diego area. The oil spill model predicts very low (less than 5 or 10 percent), or negligible, hits on land segments or resources in the Baja area from oil spills in the Southern California Bight. Therefore, the impact on pelagic seabird populations off Baja would be low.

v. Central California Impacts: The only impacts on pelagic seabird populations off central California from this proposed sale would be from oil spills from tankering production from the Santa Barbara Channel and Santa Rosa and Tanner-Cortes Banks areas. The oil spill model predicts only 0.65 spills greater than 1,000 bbl for the Ventura to San Francisco tankering leg. The transportation phase would start in 1982, or 3 years after the proposed sale. Production for the proposed sale area would peak about 7 years after the proposed sale, or in 1986. The probability tables in POCS Reference Paper No. VI for central California predict probabilities of less than 6 percent for spills reaching central California land segments or resources from this proposed sale. Any spill along tankering leg T9, T10 and T11, shown in Figure 1-A of POCS Reference Paper No. VI, would have the greatest probability for impacting pelagic seabird populations.

vi. Cumulative Impacts

Southern California Bight. The related projects considered for cumulative impacts in the area along with the proposed action are described in Section I.C.5. The greatest additional OCS oil and gas activity from existing and proposed Federal and State development will be in the Santa Barbara Channel, followed by the San Pedro Bay area and the Tanner-Cortes Banks area. The Santa Rosa area and Santa Barbara Island area will have associated OCS development from Federal Sale No. 35 leases, while the Dana Point-San Diego area will have no additional existing or projected OCS development except from this proposed sale. Increased tanker traffic in the Santa Barbara Channel and San Pedro Bay area will result from existing imports of foreign crude, additional tankering of Alaskan crude through the Santa Barbara Channel to Long Beach, tankering of Elk Hills oil production from Port Hueneme to Long Beach and San Francisco through the Santa Barbara Channel, and LNG tankering either in the Santa Barbara Channel or in the San Pedro area.

Additional, cumulative impacts on the pelagic seabird populations and prey in the Bight from drill cuttings, drilling muds, sewage waste, and formation water discharge and sedimentation effects from pipeline burial should be low. Any effects would be similar to those discussed previously.

The additional, cumulative impacts on the pelagic seabird populations from acute and chronic oil spills would produce the greatest effects. The oil spill model predicts a total of 19 oil spills greater than 1,000 bbl and 42.76 spills from 50 to 1,000 bbl from proposed Sale No. 48, existing Federal leases, and tankering of Alaskan and foreign crude into the area. This does not include spills from existing and projected State tidelands development within 4.8 km (3 miles) of the coast. The model predicts a total of 5 greater than 1,000 bbl spills from proposed Sale No. 48 development, 9.3 spills from existing Federal OCS leases,

and 4.7 spills from Alaskan and foreign tankering. Oil spills from 50 to 1,000 bbl size are predicted as 11.15 spills for proposed Sale No. 48 development and 31.61 from existing Federal leases and tankering of Alaskan and foreign crude. These projections assume a pipeline-tanker transportation mix for offshore production from proposed Sale No. 48 and existing Federal leases. If 100 percent of the oil production is tankered from proposed and existing Federal leases, the model predicts 11.6 greater than 1,000 bbl spills for the Bight versus 14.3 greater than 1,000 bbl spills from a mix of pipeline and tanker transportation.

As mentioned previously, the greatest potential for additional oil spill impacts on the pelagic seabird populations would be in the Santa Barbara area (9.63 greater than 1,000 bbl spills and 18.78 50 to 1,000 bbl spills) followed by the San Pedro Bay (4.96 greater than 1,000 bbl spills and 14.56 to 1,000 bbl spills) and the Tanner-Cortes Banks area (8.67 greater than 1,000 bbl spills and 8.14 50 to 1,000 bbl spills). The cumulative oil spill impacts on the seabird populations in the Santa Rosa, Santa Barbara Island, and Dana Point-San Diego areas would be low. All of these predicted spills are totals projected over the expected 25-year life of the fields.

For the Santa Barbara Channel area, the probability of a greater than 1,000 bbl spill hitting the highest concentrations of pelagic seabirds in the Channel in April-June increases from 73 percent for within 3 days to 80 percent within 60 days for both proposed and existing leases. The probability for 100-percent tanker transportation and for mixed pipeline and tankering is about the same. The impacts of this predicted oil spill could be significant since it would occur in an extreme impact potential area as mapped in Figure III.C.1.d-1. The probability is about the same for 1 major spill hitting the dense pelagic seabird population in the northeast corner of the Channel in fall and winter. Again, the impact of this predicted spill could be significant since it would occur in an extreme impact potential area.

For the San Pedro Bay area, the impacts of a major spill would be similar to the Santa Barbara Channel for any spill hitting the northwest corner of the Bay, which is an extreme impact potential area and a migration pathway for waterfowl.

For the Tanner-Cortes Banks area, the impacts on seabird populations in the winter months could be significant. For both existing and proposed leases, the spill model predicts 1 major spill hitting the area within 3 days with a probability of 72 percent, and increasing to 79 percent for within 10 days. For within 30 days, the probability increases to 87 percent for 2 spills hitting the Banks and for within 60 days, the probability increases to 91 percent for 2 spills. This area is in a moderate to substantial impact potential area as mapped in Figure III.C.1.d-1.

The chronic, long-term effects of additional oil spills from the proposed and related actions are unknown. Overall, the long-term, chronic additions of hydrocarbons to the marine environment in the Bight from the proposed and related actions must be put in perspective to the large daily oil seepage from natural seeps over thousands of years (40 to 670 bbl/day estimated for the Santa Barbara Channel alone), the large daily oil and grease discharges from land sewer outfalls (6 to 596 bbl/day estimated for each of 6 major outfalls), and oil runoff from rivers, creeks and drains from land (1 to 27 bbl/day from 14 major sources).

The cumulative, long-term effects of human disturbance activity from increased OCS development in the Santa Barbara Channel, Tanner-Cortes Banks, and San Pedro Bay area are unknown. Tanker traffic and increased OCS development activity would be heaviest in the Santa Barbara Channel. The Channel is heavily used by seabirds and about one-half of the area is in the substantial to extreme impact potential category as mapped in Figure III.C.1.d-1. The San Pedro Bay area would receive the next highest level of cumulative impacts from increased OCS development activity and increased tanker traffic from Alaskan and foreign oil imports. The northwest corner of the San Pedro Bay area is in the extreme impact potential category.

Baja California. The only additional, cumulative impacts on seabird populations off Baja California would result from additional oil spills reaching the area. Any spills reaching the waters off Baja from the Southern California Bight will generally remain offshore and be in a dispersed, weathered state. The impacts on the seabird populations would be low.

Central California. Once again, increased oil spill impacts from tankering would produce the major effects on seabird populations. The increased tankering from Alaskan crude and cumulative oil production from the Santa Barbara Channel and Tanner-Cortes Banks areas would increase the probability of spills along tanker legs T9 through T12 and T1 through T4 (see Figure 1-A in POCS Reference Paper No. VI). Impacts on the seabird populations from acute spills could be significant. Long-term, chronic impacts on seabird populations from spills associated with increased tanker traffic along the coast are unknown.

Summary of Impacts

Most impacts of the proposed lease sale areas would take place in the Southern California Bight (SCB). The most significant impact as a result of the lease sale to pelagic birds would be the 5.0 oil spills, greater than 1,000 bbl, that are expected to occur in the SCB. The direct impact of an oil spill is not believed able to cause the extinction of any pelagic seabird species found in the SCB. Population levels could be depressed by an oil spill but recovery to a pre-oil spill population level is assumable. The long-term toxic and sublethal effects from oil could cause the most significant impacts on pelagic seabirds. The existence and/or magnitude of these effects are, as yet unknown.

e. Impacts on Marine Mammals

i. Impacts on Marine Mammals of the Southern California Bight: Development of the Southern California OCS area could possibly affect some 32 species of marine mammals (Section II.E.6, Volume I). The majority of these species are cetaceans which either reside in or migrate through the lease area.

Each phase of offshore petroleum development carries with it several sources of potential hazards to marine mammal populations (Table III.C.1.e-1). Since offshore petroleum development activities have both at-sea and onshore components and typically span over several decades, there exist, in addition to obvious catastropic events (such as wellhead blowouts), chronic, low-intensity impacts. The cumulative effect of chronic, low-intensity impacts (such as seepage, boat traffic, etc.) may be as significant over time as the impact of short-term, high-intensity events (such as oil spills). In addition, more subtle ecosystem effects may occur that may profoundly alter the animals' supporting biological medium. Unfortunately, there are no unequivocal data available demonstrating adverse effects of small amounts of oil in ecosystems or on marine mammals.

Essentially, three types of hazards to marine mammals may occur as a result of offshore petroleum development. These are: 1) floating oil; 2) increased human activity and disturbance; and 3) ecosystem contamination.

Contact with floating oil affects marine mammals in four obvious ways: 1) by fouling of fur; 2) by ingestion; 3) by inhalation; and 4) by irritation of eyes and membranes. When oil contaminates fur, two important physiological changes occur; buoyancy decreases and normal thermal resistance is impaired. Of the two, destruction of the insulation properties of the body covering is probably more damaging.

Fur seals depend on the integrity of their underfur for insulation and spend considerable time grooming their pelage with their nails and mouth. Kooyman (cited in Gentry, Johnson and Holt, 1976) reported preliminary data on the effects of application of Prudhoe Bay crude oil to fur seal pelts and live captive animals. He found that 1.7 to 2.0 times as much heat was conducted through oiled pelts than normal, unsoiled ones and that the metabolic rate during immersion of oiled, experimental animals was 1.5 times that of controls. Obviously, oiling causes considerable heat loss in fur seals.

Nothing is known of the habits of seals and sea lions or cetaceans and sea otters encountering floating oil at sea. Limited information is available regarding impact to seal and sea lion populations hauled-out in areas where oil has washed ashore.

Table III.C.1.e-1

SOURCES OF POTENTIAL HAZARDS TO MARINE MAMMALS, RESULTING FROM OFFSHORE OIL DEVELOPMENT AND PRODUCTION

Activity or Facility	Chronic Hazards	Catastrophic Events
Exploration		
Seismic profiling	Noise, "startle" effects	Sub-surface noise - Concussion
Drilling		Siltation
Boat traffic	Prop hits	Downstream pluming
		Opacity increases
Operation		
Onshore facilities	Disturbance near reproductive areas of sensitive mammal populations (depends on site)	Disturbance in construction
Staging areas		
Pumping stations		
Tank farms		
Separation plants		
Refineries		
Offshore facilities		
Production platforms		
Well-head	Leekage/seepage	Blow-out
Support		
Crew and supply boats	Sub-surface noise and propeller hits	
Aircrafts	noise in air	
Transport		
Pipelines	Leakage	Rupture
Pumping buoys	Leakage	
Barges and tankers	Bilge Oil	Collision or grounding
Clean-up		
Oil on water		Boat activity
Skimmers		
Burn-off		Pollution--air
Chemicals		Pollution--water
Grounded oil		
Booms		Disturbance to sensitive marine mammal populations on islands by human instrusion and aircraft activity
Straw		
Chemicals		

Shortly after the 1969 platform blowout in the Santa Barbara Channel, biologists determined percentage mortality for northern elephant seal and California sea lion pups, percentage oil-fouled, and tagged oily and clean living pups (Le Boeuf 1971; Brownell and Le Boeuf 1971). It was determined that significantly more dead California sea lion pups were oil-fouled than living pups; however, no cause-and-effect relationship could be postulated from the scant data. Northern elephant seal pups, perhaps, faired somewhat better, in spite of the fact that the blowout occurred during the breeding season. Tag returns showed that oily pups survived as well as clean pups. Because the oil contamination occurred after the pups were weaned, they fortunately did not ingest oil as they suckled from their mothers. Had the blowout occurred two weeks earlier, the impact might have been severe. An oil spill that contaminated a gray seal rookery in Wales resulted in significantly lower peak weight of oiled pups and a very high overall mortality (both oily and clean pups) (Davis and Anderson 1976). Though the high pup mortality was apparently related to oil clean-up activities with accompanying disturbance, stress and disruption of the social structure, the ultimate survival of the smaller, oily pups remains in question.

Acceleration of offshore petroleum development necessitates increases in ship and aircraft traffic near offshore facilities and between these facilities and the shoreline. The probability of intrusion upon land areas used by animals for reproduction is also increased.

It is not known how ship or aircraft noise affects animals in or above the water. Some cetaceans are known to utilize acoustic information for navigation, maintenance of social bonds, and foraging. A dramatic increase in ambient noise levels or in the incidence of "startling," high-intensity, short-period sounds may well preclude successful hunting or make orientation or social cohesion much more difficult for these animals. The pinnipeds found in the Southern California Bight are not known to hunt acoustically, though this possibility should not be overlooked.

All floating or swimming animals are liable to being hit by boats. This is particularly true of small cetaceans, who depend on a reasonably normal acoustic environment for spatial and social orientation and would thus be more liable to being struck in the vicinity of a ship's noise.

Disturbance of pinniped colony areas on land is a more tangible and well-known hazard. Disturbance is much more than an inconvenience to these animals--their reproductive activities may be completely

disrupted by human intrusion or aircraft flyovers at critical times. Among pinnipeds, adult animals may stampede to the water at the sight of man, leaving pups behind. Mother-pup separation is a major source of pup mortality. There appears to be no alternative breeding/ pupping sites in the Southern California Bight. Therefore, if these disturbances continued, the pinniped population levels should decline.

Reproductive rookeries are used traditionally by pinnipeds and repopulation following disturbance may in some cases require decades. Similarly, disturbance of gray whales by boating activity is thought to have led to abandonment of San Diego Bay as a calving ground several decades ago--they have never resumed breeding in this location.

There is much evidence that the productivity of colonially-breeding animals is limited by the availability of food. The location of pinniped colonies is closely tied to location of foraging areas; even small changes in the abundance of prey, time required for foraging, or nutritional suitability of prey can cause major alterations in reproductive ecology.

The same can be said of important traditional migration routes. Over evolutionary time migrating whales and seals have selected routes offering the optimal feeding areas, lowest mortality rates, and ease of passage. Any action causing animals to avoid traditional migratory routes, or result in the loss of an important feeding area along such a route might well be very detrimental to a population as a whole.

No one really knows how spilled oil or its metabolities, drill muds, or trace metal pollutants affect marine food chains or whether environmental alterations due to offshore oil production can preempt or spoil a major feeding area. This is not to say that such effects do not exist but rather that long-term food chain experiments are being conducted but results are, so far, inconclusive.

All of the populations of marine mammals that frequent the waters off Southern California are, to some extent, vulnerable to impacts associated with development of offshore oil and gas resources. However, by virtue of their small size, insularity, extreme susceptibility to contamination by floating oil, or narrow behavioral or ecological tolerances, some populations are so vulnerable to these impacts that catastrophic damage might result from even minimal changes in their environment. A listing of these vulnerable species appears in Table III.C.1.e-2.

Table III.C.1.e-2

MARINE MAMMAL SPECIES OF THE SOUTHERN CALIFORNIA BIGHT
MOST VULNERABLE TO IMPACTS FROM OFFSHORE PETROLEUM DEVELOPMENT

Species	Comments
Northern fur seal	Extremely vulnerable to exposure, stress and loss of buoyancy resulting from oiling of fur; especially susceptible to oiling at the Castle Rock rookery on San Miguel Island.
Guadalupe Fur Seal	Species expanding its range north; the few individuals occurring in the SCB are very susceptible to elimination.
All pinnipeds	Moderately to very susceptible to disturbance of rookery areas and hauling grounds; pups may ingest oil during suckling if mother is fouled.
	- - - - -
California gray whale	Endangered species; migrates predominantly in band from 0 to 15 km off the mainland.
Blue, fin, humpback, sei, and sperm whales	Endangered species; population numbers small; migrate along western margin of the Southern California Bight.
Pilot whale	Susceptible during winter; seasonal feeding concentration in shallow waters surrounding southeastern portion of Santa Catalina Island.
Pacific Right Whale	Endangered species; population very small, sighted off the coast of California in 1956.

The preceeding discussion has been a general description of probable and/or possible impacts on marine mammals of the Southern California Bight. The following discussions will deal with specific impacts expected for each of the six subdivisions of the proposed lease sale.

Santa Barbara Channel Area Impacts. This area is the single most significant area, in terms of possible impacts on marine mammals within the Southern California Bight. All of the northern Channel Islands (with the exception of Anacapa) have pinniped breeding areas on their shores and all have haul-out areas (see Visual No. 8). In addition, the Channel itself serves as a major migration corridor for cetaceans.

San Miguel Island (including Castle Rock) is by far the most important of the islands in terms of pinniped activity. California sea lions, northern sea lions, northern elephant seals, northern fur seals and harbor seals all have rookeries on the island. The western tip, around Point Bennett is by far the most important, although northern elephant seal rookeries also occur within the Tyler Bight and around the Crook Point area, and harbor seal rookeries occur mostly along the north shore (Simonton Cove, Bat Cove, Bay Cove and Glass Float Beach) and at Crook Point on the south shore. Castle Rock (1 km offshore) to the north of Point Bennett is an important breeding area for California sea lions and northern fur seals. Small numbers of adult and immature Guadalupe fur seals have been sighted on San Miguel Island annually since 1968.

According to the oil spill risk model (POCS Reference Paper No. VI) for this lease sale a major (1,000 bbl or more) oil spill anywhere within the Channel area and the Santa Rosa lease area would hit the island. The most significant hazards would occur from a spill within the western half of the Channel where spilled oil would be expected to hit shore within 3 days. The major sources of spilled oil impacts would be in the vicinity of Lease Tract Nos. 1-17, 21-25, 31-36, 48-53 and those existing leases to the north of San Miguel Island. Development within the eastern half of the Channel would have relatively low probabilities of hitting the shore within 3 days with the major impacts occurring between 3 and 10 days. Oil spilled in the vicinity of the Santa Rosa lease area may hit San Miguel although the probability is very low.

As mentioned previously, a major spill would have the greatest possible impacts if it occurred during the breeding season. In the case of San Miguel Island this would be between March and August, and December to February for one or more species.

Harbor seals are the only species with rookeries on Santa Rosa and Santa Cruz Islands. There the greatest effects of a spill would be felt from March through May.

Impacts of other activities associated with offshore oil development, as discussed previously, could occur throughout the year but would be most significant during the breeding seasons.

San Pedro Bay Area Impacts. Only one pinniped rookery could be impacted from development within this area. A small herd of harbor seals hauls-out and breeds near China Point or the west side of Santa Catalina Island. In addition, California gray whales migrate through the San Pedro Channel and pilot whales form feeding concentrations during the winter months in the shallow waters surrounding the southeastern portion of Santa Catalina Island.

It is very unlikely that a spill occurring within the San Pedro Bay area would impact the western side of Santa Catalina and the harbor

seal rookery at China Point. Such a spill, however, may have rather significant impacts upon the pilot whale concentrations during the winter months off southeastern Santa Catalina and on gray whales migrating through the area.

Chronic impacts such as increased human activity, noise and low-level pollution may also affect the whales using this area. Ecosystem contamination could significantly affect the food organisms of the pilot whales; therefore, affecting pilot whales, themselves, and other cetaceans dependent upon those food organisms.

Dana Point - San Diego Impacts. Generally, impacts upon marine mammal populations from offshore development within this area are expected to be minimal. The greatest hazards would be presented by the northernmost tracts, decreasing to the south. Only three pinniped rookeries occur anywhere close to this area: 1) a harbor seal rookery at China Point on the west side of Santa Catalina Island; 2) a California sea lion rookery at Seal Cove on the west shore of San Clemente Island; and 3) a northern elephant seal rookery at West Cove on South Island of Los Coronados. In addition, California gray whales migrate through the area and several dolphin species are regular visitors.

Chronic impacts from human activities and noise may present a greater threat to marine mammals occurring within this area than from a major spill. However, in view of the basic assumptions regarding most probable development, overall impacts to marine mammal populations are expected to be minimal.

Santa Rosa Area Impacts. As mentioned previously, development within this area may affect pinniped rookeries on San Miguel, Santa Rosa and Santa Cruz Islands. However, based on estimates from the oil spill risk model (POCS Reference Paper No. VI) the area most likely to be impacted from these leases are along the Santa Rosa-Cortes Ridge, including San Nicolas Island.

San Nicolas Island is second only to San Miguel in terms of numbers of breeding pinnipeds occupying its shores. California sea lion and northern elephant seal rookeries occur along the southwestern shore north of Dutch Harbor and a small harbor seal rookery occurs at a small cove near the northern tip of the island.

Recent surveys conducted by the University of California have identified the entire Santa Rosa-Cortes Ridge as a major feeding area for marine mammals.

Marine mammal populations utilizing the Santa Rosa-Cortes Ridge area and those breeding populations on San Nicolas Island would be subject to any one or all impacts previously described. However, the possibility of a major spill impacting San Nicolas Island are

predicted at less than 20 percent even after 60 days (see Oil Spill Model, POCS Reference Paper No. VI).

Tanner-Cortes Area Impacts. This area has been identified as an important feeding area for marine mammal populations. Therefore, the major impacts could result from chronic affects upon food organisms rather than from a major spill. This area is far enough removed from major breeding areas that a major spill probably would not affect these areas, although feeding animals may become oiled (see previous discussion).

Santa Barbara Island Impacts. Santa Barbara Island is the site of several California sea lion rookeries totaling less than 2,000 animals and a small northern elephant seal rookery of just over 100 individuals. These rookeries occur almost completely around the island.

Chronic low-level impacts, such as disturbance, noise and pollution could have rather significant effects upon breeding animals on Santa Barbara Island, especially from June through August and December through February. In addition, a major spill impinging upon the island during these months would have its greatest effects upon these breeding populations.

In the event of a major oil spill from this lease area, any one of the islands (with the exception of San Miguel) may be impacted with the greatest probabilities (after Santa Barbara Island) occurring on Santa Catalina and San Clemente. Due to the rather small numbers of breeding animals on these islands, and the restricted breeding areas, overall impacts upon marine mammals are expected to be very limited.

ii. Impacts on Marine Mammals of Baja California: Marine mammal populations of Baja California are not expected to be significantly impacted from chronic events such as human disturbance, noise and low-level pollution resulting from normal daily operations on leases resulting from the proposed sale.

Impacts upon marine mammal populations may occur primarily as a result of a major spill within the Tanner-Cortes area or the San Diego area leases. However, the significance of such an event decreases quite rapidly southward across the international boundary. The most significant breeding areas for marine mammals (Guadalupe Island, Cedros Island, San Benito Island, and Scammons Lagoon) are all quite far south and impacts, if any, are expected to be marginal. Areas which can possibly be affected by a major spill drifting south are shown in Figure II.E.6-1 (Chapter II).

iii. Tankering Leg Impacts (Point Conception to Point Reyes): Areas of possible impact on marine mammal populations within the Central California area from Point Conception to Point Reyes are illustrated in Figures II.E.6-2 (Chapter II). The most significant areas are Ano Nuevo Island off Ano Nuevo Point (San Mateo County) and the Farallon Islands off San Francisco.

Tankering of crude oils produced within the Southern California area is expected to be the only activity resulting from the proposed lease sale impacting this area. Of possible exception are impacts upon mainland haul-out and breeding areas of harbor seals along the San Luis Obispo County shoreline from normal operating activities in leases within the extreme northwestern section of the Santa Barbara Channel. In addition, a tanker accident at the southern end of this area (between Point Buchan and Point Conception) resulting in a large spill may hit San Miguel Island and affect the pinnipeds there.

Tankering traffic itself is not expected to significantly affect marine mammals of this area although tanker noise may hinder whale migrations. The general tanker routes are far enough offshore that they are not expected to disturb pinnipeds on land or sea otters inhabiting the inshore waters.

Chronic low-level pollution resulting from tanker ballast discharge could affect ecosystem balance important to marine mammal populations in the area. However, available data are inadequate to predict the extent of such impacts.

A major spill is the most likely cause of significant impacts expected as a result of tankering. As mentioned previously, only two areas are of major concern in terms of pinniped activity. These are: Ano Nuevo Island and the Farallon Islands. The near shore area between Point Pinos and Point Sur (Monterey County) is of concern as the center of the sea otter range. A tanker spill hitting any one of these areas would have significant impacts on either pinnipeds or sea otters. Probably of greatest concern is the sea otter range.

The sea otter (*Enhydra lutris*) is unique among marine mammals and is similar to birds in that it has no insulating blubber layer. It is also similar to birds in that the otter is protected from environmental temperatures by an air blanket trapped among the dense fur fibers of its pelt. If the water in which the sea otter lives is polluted by any foreign substance that causes the fur to mat or otherwise lose its water-repellent character, water reaches the skin, body temperature is lost and the otter soon dies of exposure. The California population of the sea otter has been designated by the Federal Government as a threatened species. This designation was made primarily because of the sea otter's extreme vulnerability to oil spills.

Accidental exposure of two sea otters to a small but unknown amount of oil (probably diesel) in an experimental holding pool on Amchitka

Island resulted in fur matting, progressively severe distress, emergence from the water, and death by exposure within several hours (K. W. Kenyon, unpublished data). The oil in this case formed a visible sheen, comparable to that sometimes present in harbor areas where gulls appear unaffected by it. Similar or greater petroleum pollution in the marine environment would prove fatal to any sea otter that came in contact with it.

The direct effect of oil spills, and/or oil pollution during intentional oil discharge from tanker cleaning operations at sea would very likely be to kill sea otters. Indirect impacts from oil spills or chronic discharge to the sea otter are possible, as well. If these pollutants were to destroy the sea otter's food supply, the sea otter would starve.

iv. Cumulative Impacts: The cumulative effects of the proposed lease sale, existing Federal and State offshore leases, existing oil transportation and additional oil and LNG transportation needs will add stresses (e.g. disturbance, pollution, etc.) upon marine mammal populations already under stress. Recent observations of gray whale migrations have indicated that historical inshore routes are being abandonded (or at least appear so) for routes farther offshore (presumably to less "disturbed" areas). The major pinniped breeding islands within the Southern California Bight (San Miguel, San Nicholas and Santa Barbara) are the farthest offshore.

Probably the area which stands to receive the greatest impact from the proposed sale is the Santa Barbara Channel area. Considering existing human activities within this area and proposed activities expected to impact the area (e.g. this lease sale, LNG terminals, additional tankering, space shuttle, etc.), the additional stresses imposed upon marine mammal populations are expected to be quite significant. The probability of major oil spills alone are greatly increased (see Section III.A.4). If just San Miguel Island, as the major pinniped breeding island is considered, the probability of a major spill (1,000 bbl or more) occuring and hitting the island within the next 20 years is about 50 percent (see Section III.A.4).

v. Conclusion: In summary, while the impacts of the proposed lease sale in itself are not excessive, the accumulation of impacts from all activities occurring and expected within the Southern California Bight is most likely to be quite significant. The one area most significantly impacted will be the Santa Barbara Area and especially the San Miguel Island area if accelerated offshore development were to occur within the western half of the Channel. The expected number of spills in the Bight and increased activity could possibly eliminate the dozen or more Guadalupe fur seals that occur in Southern California. Oil spills or the chronic presence of oil in the marine environment could adversely impact the food supply of marine mammals. This impact, should it occur, would be very significant.

f. Threatened/Endangered Species: Section II.F.6 and POCS Reference Paper No. II list and discuss all the rare, threatened or endangered species found between Point Reyes and Punta Eugenia. Table III.C.1.f-1 lists the most probable levels of impacts upon those species for which consultation was requested by BLM with the NMFS and FWS under Section 7 of the Endangered Species Act of 1973. That is, those species which, after careful analysis, were thought to have some potential for impact from proposed Sale No. 48.

Some species, proposed for inclusion on the Threatened and Endangered Species List, are included in the table. Categories of impacts are: very remote, minor (5 percent or less of Population Injured, Destroyed or Displaced PIDD); moderate (6-15 percent PIDD); heavy (16-30 percent PIDD); and severe (more than 30 percent PIDD). These impacts are only for those organisms in the project area. Members of the same species living in other parts of the world are not included. (For example, the endangered leatherback sea turtle could suffer moderate impacts in the project area; however, less than 1 percent of the world population of leatherback turtles occurs in the project area so impacts of the proposed sale on the species as a whole would be insignificant.)

The last two columns in Table III.C.1.f-1, entitled Worldwide Long term, reflect the most probable long-term level of impacts on the world population of each species. Long term in this case is 10 years. The 48 column lists most probable impacts from the proposed sale; Cum. lists the cumulative impacts from all projects.

For a discussion of the mechanisms of how different events can affect different species, refer to the following sections: III.C.1.d, III.E.3, (birds) III.C.1.e (whales, seals, sea otters); III.E.2 (vegetation); and III.E.4 (terrestrial mammals).

Comments are made on species when combined impacts (from Sale No. 48) were rated moderate, or worse. Some remarks are also made concerning other species.

The proposed Sale No. 48 impacts on most of the whales in the Bight will probably be minor. Gray whales, however, regularly migrate through the proposed lease area. This behavior exposes the entire California gray whale population to a serious potential threat (Regents, University of California, 1976). If a large spill occurred in the Santa Barbara Channel during a migration, a high percentage of the total population could be impacted. It must be pointed out that oil impacts on whales are theoretical. Data does not exist to prove the impacts. However, the need to surface to breathe, the location of the blowhole, and sensitivity of respiratory tissues and eyes to oil have led many cetacean researchers to believe whales are potentially very vulnerable (Regents University of California, 1976).

Table III.C.1.f-1[a]

MOST PROBABLE POTENTIAL IMPACTS ON ENDANGERED SPECIES BETWEEN POINT REYES AND PUNTA EUGENIA

(R = Very remote probability of any impacts, Min = Minor, M = Moderate, H = Heavy, S = Severe)
(See narrative for a definition of these terms)

Organisms	Most Probable Level of Impacts from Most Probable Sources Point Reyes To Punta Eugenia								Worldwide Long Term	
	Traffic, Boat, Air	Exploratory Drilling Activity	Mud Cuttings Form. H_2O	Prod. Plat	Pipeline Const.	Oil Spills & Cleanup	Combined Sale 48 Impacts	Cum. Of All Proj.	Sale 48	Cum.
I. Mammals										
Whales										
1. Gray	Min	Min	R	Min	Min	M	M	M	M	M
2. Humpback	Min	Min	R	Min	Min	M	M	M	Min	Min
3. Pacific Right	Min	Min	R	Min	Min	M	Min	M	Min	Min
4. Blue	Min	Min	R	Min	Min	M	M	M	Min	Min
5. Sei	Min	Min	R	Min	Min	M	Min	M	Min	Min
6. Sperm	Min	Min	R	Min	Min	M	Min	M	Min	Min
7. Fin	Min	Min	R	Min	Min	M	Min	M	Min	Min
Seals										
8. Guadalupe Fur	Min	Min	Min	Min	Min	S	S	S	Min	M
Sea Otters										
9. Southern Sea	R	R	R	R	R	Min	Min	M	Min	Min
Terrestrial Mammals										
10. Salt Marsh Harvest Mouse	R	R	R	R	R	Min	Min	Min	Min	Min
11. Morro Bay Kangaroo Rat	R	R	R	R	R	R	Min	Min	Min	Min

O Very remote
Min Minor (5 percent or less of Population Injured, Destroyed or Displaced PIDD)
M Moderate (6 to 15 percent PIDD)
H Heavy (16 to 30 percent PIDD)
S Severe (more than 30 percent PIDD)

Table III.C.1.f-1[a] (Cont.)

Organisms	Most Probable Level of Impacts from Most Probable Sources Point Reyes To Punta Eugenia: Traffic, Boat, Air	Exploratory Drilling Activity	Mud Cuttings Form. H_2O	Prod. Plat	Pipeline Const.	Oil Spills & Cleanup	Combined Sale 48 Impacts	Cum. Of All Proj.	Worldwide Long Term: Sale 48	Cum.
II. Birds										
11. Brown Pelican	Min	Min	Min	Min	Min	M	M	H	Min	Min
12. Aleutian Canada Goose	R	R	R	R	R	Min	Min	Min	R	Min
13. California Clapper Rail	R	R	R	R	R	Min	Min	Min	Min	Min
14. Light-Footed Clapper Rail	R	R	R	R	R	Min	Min	Min	Min	Min
15. California Black Rail	R	R	R	R	R	Min	R	Min	R	Min
16. California Least Tern	R	R	R	R	R	M	Min	Min	Min	Min
17. American Peregrin Falcon	R	Min	R	R	R	M	M	M	Min	Min
18. Beldings Savannah Sparrow	R	R	R	R	R	Min	Min	Min	Min	Min
19. San Clemente Loggerhead Shrike	R	R	R	R	R	Min	Min	Min	Min	Min
20. San Clemente Sage Sparrow	R	R	R	R	R	R	R	Min	R	Min
21. Bald Eagle	Min	R	R	R	R	Min	Min	Min	Min	Min
III. Reptiles										
Sea Turtles										
22. Leatherback	Min	Min	Min	Min	Min	M	M	M	R	Min
23. Hawksbill	Min	Min	Min	Min	Min	M	M	M	R	Min
24. Green	Min	Min	Min	Min	Min	M	M	M	R	Min
25. Loggerhead	Min	Min	Min	Min	Min	M	M	M	R	Min
26. Olive Ridley	Min	Min	Min	Min	Min	M	M	M	R	Min
IV. Insects										
Butterflies										
27. El Segundo Blue	R	R	R	R	R	Min	R	Min	R	Min
28. Smith's Blue	R	R	R	R	R	Min	R	Min	R	Min
29. Mission Blue	R	R	R	R	R	R	R	R	R	R
30. San Bruno Elfin	R	R	R	R	R	R	R	R	R	R

O Very remote
Min Minor (5 percent or less of Population Injured, Destroyed or Displaced PIDD)
M Moderate (6 to 15 percent PIDD)
H Heavy (16 to 30 percent PIDD)
S Severe (more than 30 percent PIDD)

Table III.C.1.f-1 (Cont.)

Organisms	Most Probable Level of Impacts from Most Probable Sources Point Reyes To Punta Eugenia								Worldwide Long Term	
	Traffic, Boat, Air	Exploratory Drilling Activity	Mud Cuttings Form. H_2O	Prod. Plat	Pipeline Const.	Oil Spills & Cleanup	Combined Sale 48 Impacts	Cum. Of All Proj.	Sale 48	Cum.
V. Molluscs										
31. Banded Dune Snail	R	R	R	R	R	Min	Min	Min	R	Min
VI. Plants										
32. San Clemente Broom	R	R	R	R	R	Min	R	Min	R	Min
33. San Clemente Island Bushmallow	R	R	R	R	R	Min	R	Min	R	Min
34. San Clemente Island Larkspur	R	R	R	R	R	Min	R	Min	R	Min
35. San Clemente Island Indian Paintbrush	R	R	R	R	R	Min	R	Min	R	Min
36. *Astragalus miguelensis*	R	R	R	R	R	Min	R	Min	R	Min
37. *Astragalus pycmostachyus lanosissium*	R	R	R	R	R	Min	R	Min	R	Min
38. Santa Barbara Liveforever	R	R	R	R	R	Min	R	Min	R	Min
39. Little Sur Manzanita	R	R	R	R	R	Min	R	Min	R	Min
40. Surf Thistle	R	R	R	R	R	Min	R	Min	R	Min
41. Saltmarsh birds beak	R	R	R	R	R	Min	R	Min	R	Min
42. Prostrate nosackia	R	R	R	R	R	Min	R	Min	R	Min

[a]All the references listed for this section were used in compiling this table.

O Very remote
Min Minor (5 percent or less of Population Injured, Destroyed or Displaced PIDD)
M Moderate (6 to 15 percent PIDD)
H Heavy (16 to 30 percent PIDD)
S Severe (more than 30 percent PIDD)

Assuming that gray whales are migrating through the Bight from November through April (6 months), and that a spill could impact whales for 2 months after its occurrence, there is a period of 8 months, September through April, when a spill could affect these whales. That is, for 2/3 of each year the gray whales could be affected. The expected number of spills during the life of the project is 3.1 and 5.0 for the Santa Barbara Channel and for the entire Bight, respectively. Since the gray whales are not always present these values must be multiplied by 2/3 to determine the expected number of 1,000 bbl, or greater, spills that will occur when the whales are present. The expected numbers are 2.1, for the Santa Barbara Channel, and 3.4 for the entire Bight. Of course, these figures do not take into account where the spill is and where the whales are, other than within the large general areas. Also, it does not consider the possibility of the whales avoiding a spill.

In addition to impacts from oil, evidence indicates increased nearshore activity may be driving gray whales out of their normal migration corridor of 1 to 15 km off the mainland coast. Conclusive evidence as to whether or not increased nearshore activities, such as recreational and commercial boating, whale watching excursions, and activities associated with offshore oil development, is driving gray whales farther offshore is not available. However, since the gray whales are known to be able to migrate without the benefit of keeping land in sight, and therefore, if the gray whales are, indeed, driven offshore, this should cause no major impact to the gray whales.

Blue whales migrate primarily at the seaward edge of the continental borderland. There are so few blue whales left that any losses due to oil spills could have a serious effect. Humpback whales use the Santa Barbara Channel as a seasonal gathering ground. As with gray whales, large numbers of humpbacks could be simultaneously impacted. Pacific right whales are also extremely scarce, an estimated 220 individuals in the north Pacific. Any losses would be very serious. Fortunately, these whales rarely occur in the project area so their chances of being impacted are slight.

Long-term, worldwide effects on the whale species listed will probably be minor for all species except the gray whale. The migratory habits of the gray make it much more vulnerable than the other whales.

Fur seals rely heavily on their fur for insulation. Oil reduces most of the insulative qualities of the fur, resulting in rapid heat loss. It also causes a loss of buoyancy (Regents University of California, 1976). These factors normally lead to death. Oiling of the eyes produces extreme irritation and can result in blindness (Geraci and Smith, 1976 and Gentry, et al., 1976). As a result, fur seals are one of the most vulnerable marine organisms to oil pollution. The expected number

of spills in the Bight and increased activity could eliminate the dozen or so Guadalupe fur seals that occur in Southern California.

It should be pointed out, however, that those dozen or so Guadalupe fur seals are believed to represent a transient, non-breeding group. Although this species was once numerous in Southern California, nearly all of the estimated 1,200 individuals are now found on Guadalupe, San Benito and other islands off Baja California. Therefore, even if the dozen or so California individuals were killed it would not have more than a minor impact on the entire population. However, it could adversely affect the reestablishment of a breeding colony of these seals off Southern California.

The probabilities of oil (from proposed Sale No. 48) reaching the Mexican islands which support most of these seals is low, 5 percent and less depending upon the transportation scenario chosen. Nevertheless, minor losses (5 percent of the population injured, destroyed or displaced) could occur due to the vulnerability of the animals. The probabilities of oil reaching this area, from all (cumulative) projects range up to 14 percent. The most probable level of impacts from all projects combined (cumulative) is moderate.

Sea otters also depend upon their fur for insulation. They are very vulnerable to oil contaimination as a result. Fortunately, the chances of oil reaching the areas containing nearly all of California's sea otters (within 60 days) is low, <0.5 to 3 percent; however, if oil should reach these areas, the impacts could be severe.

Brown pelicans are very sensitive to human disturbance near their colonies. The preferred pipeline route, between Santa Rosa and Santa Cruz Islands, and oil spill cleanup activities could be disruptive to this species. The brown pelican's habit of diving for food, foraging all day long, to distances of more than 50 km offshore, and frequently flying in flocks make it likely to come in contact with spilled oil. Note, however, that they rely heavily on vision when diving after fish. If an oil spill obscured the fish, the birds would probably not dive. They might still land on the water to rest, however. Oiled birds cannot fly properly, if at all, cannot forage efficiently for food, generally refuse to eat and suffer rapid heat loss (Hartung, 1967). Mortalities among sea birds are always high after a spill. Some brown pelican fatalities will probably occur from the proposed sale, but the long-term, worldwide impact on this species' survival will be minor.

There are very few sea turtles in the Bight (NMFS, 1976). These animals, however, are very vulnerable to oil spills. They are relatively slow swimmers and must surface frequently to breathe. Turtles rely heavily on vision to survive. Eye damage/blindness from oil contamination would probably be fatal. Large numbers of sea turtles used to live in the

Bight, but human activity along the beaches has driven them away. In the case of the turtles, increased activity levels would probably not have more than a minor impact, at most, because of the areas where this activity would occur. The greatest threat to the sea turtles in the Bight and northern Baja California is from oil contamination.

Ten species of plants might be impacted if a spill were driven ashore on a very high tide, or during oil spill cleanup operations. The latter presents the greatest risk. Increased air pollution could also injure these plant species.

Summary of Impacts

Some mortality to threatened and endangered species may occur as a result of the proposed Sale No. 48 but the worldwide long-term effect on an affected species population should be minor, or very remote for most species, and moderate for the Gray Whale (see paragraph f.).

g. Impact on Kelp Beds: Oil deleteriously affects kelp by damaging cell membranes, reducing translocation and reducing photosynthesis. The susceptibility of plants to oil pollution varies with its life stage (Shiels, et al., 1973) and this factor may be one of the most important considerations when assessing potential impacts on kelp and other algae. The adult or sporophytre generation (see Section II.F.2 and POCS Reference Paper II.F.2) has an outer mucilage covering which appears to serve as a protection against oil toxicity. In certain species, this mucilage may be absent in reproductive forms, such as gametes and zoospores, making them potentially more susceptible to oil and increasing the probability of severe damage to a population if they are oiled during the peak reproduction season of the year.

Most marine macrophytes have a smaller attached gametophyte stage which develops from mobile single cell zoospores and forms the gametes which give rise to the large adult sporaphyte stage after fertilization. The smaller multicellular gametophytic stage of *Macrocystis* has never been found in the natural habitat, but has been examined in the laboratory. An alternate form of the multicellular gametophytic stage is a single cell gametophyte which gives rise to the sporophyte within 14 days.

According to Neushul (personal communication, 1978) all life cycle stages of *Macrocystis*, except the gametes, probably has a mucilage covering around it, suggesting some protection to the cellular contents. Except possibly for the vegetatively-reproducing population near Santa Barbara, the satisfactory culmination of all these stages is necessary for the completion of the sexual life cycle needed for the propagation and survival of the species. There is, therefore, the single cell gamete stage which probably is more susceptible to oil toxicity.

North (1971) reported giant kelp *Macrocystis* require one year to reach sexual maturity under optimal conditions, inferring that one to two years would be required for biological recovery in the event of the total destruction of a population. The bull kelp *Nereocystis* of Central California is an annual and reaches sexual maturity within a year.

The sporophytic generation of kelp is very resistant to damage from spilled oil because of the protective envelope of mucilage and was unaffected during the 1969 Santa Barbara oil blowout. The kelp beds actually protected plants and animals of the lower intertidal by holding oil back until the tide rose over them (Nicholson and Cimberg, 1971).

Even during the oil spill from the wrecked tanker TAMPICO MARU, which involved the more toxic diesel fuel, there was little evidence

of damage to the giant kelp *Macrocystis pyrifera*, and indeed increased its density after the oil spill. This was attributed to the toxic action of the oil on the animals known to be kelp grazers and the subsequent release of grazing pressure on the plants (North, et al., 1964).

Kelp has been affected by refined oil under laboratory conditions as reported by North, et al., (1964) who conducted toxicity studies with a diesel oil and found that a 0.1-percent emulsion nearly inhibits all photosynthetic activity of young *Macrocystis* blades. Clendenning and North (1960) observed that 10-100 ppm of fuel oils caused a 50-percent reduction in photosynthetic activity of algae in four days.

Neither Rossi, et al., (1977) nor Gordon, et al., 1977) reported extensive uptake or accumulation of petroleum hydrocarbons or heavy metals in kelp blades. Rossi, et al., further indicated the "presence of polymuclear aromatic hydrocarbons in a *Macrocystis* sample may be related to the trapping of particulate-bound hydrocarbons by mucoid blade coverings rather than intracellular assimilation. The question of true incorporation versus superficial association must be considered when evaluating results of all chemical analyses on marine macroalage."

The damage of the kelp bed association, especially the epifauna, caused by an oil spill is less well known. Visibility was only three inches in mainland kelp beds during the Santa Barbara blowout, so accurate determination of damage was impossible. Anderson, et al., (1969) could detect no damage to the associated fauna in the oiled kelp beds of Anacapa Island. Apparently the only damage reported to organisms of the kelp bed community was a reduction of mysids (Ebling, et al., 1971). Anderson, Neff, and Petrocelli (1974) reported the mysid *Mysidopsis almyra* to be the least tolerant to oil of all organisms tested. We do not know if mysids as a group are susceptible to the toxins in oil or if *M. almyra* is an isolated case within the group.

Oil was detained from reaching shore by kelp beds in the Santa Barbara blowout (Battelle, 1970) and possibly undetected damage resulted or could result to certain associates from prolonged exposure to the oil.

North (1971) reported that at least the majority of canopy associates are short lived organisms having a rapid turnover rate. This suggests that, provided brood stock is available from nearby unaffected or slightly affected areas, repopulation and biological recovery would be rapid, requiring several months rather than years.

Although Straughan (1971) reported barnacle larvae were inhibited from settling on oil covered surfaces on the rocky intertidal,

sessile invertebrates probably would be little affected in this manner. Nicholson and Cimberg (1971) reported oil was readily washed off kelp blades. North (1971) reported most sessile invertebrates settle on the older more senile blades which presumedly do not have quite the cleansing capacity of the younger blades which have a greater amount of mucilage covering.

From Dames and Moore (1973), who estimated the impacts caused by laying pipelines through kelp beds by jetting, blasting, and by anchoring the lines by rip-rap, we quote:

> Impacts Associated with Jetting. Large mobile organisms such as fish will simply move out of the way, but many sedentary or sluggish organisms making up the benthic community will be affected by the spoils settling to the seafloor either immediately adjacent to the trench, or down current. This will be analogous to the effects of a severe storm, with short-term redistribution of unconsolidated bottom materials. Much of the benthic community is adapted to such shifts of seafloor materials, but survival is a function of both mobility of the organism and rate and volume of cut and fill. In the immediate vicinity of the trench, mortality of the sessile or sluggish part of the benthic community will be greater than during the most severe natural catastrophic events, but the effects will diminish farther from the trench. Distribution of the spoil will depend upon the exact manner of trenching and on the wave and current conditions at the time, and cannot now be predicted. It is anticipated, however, that farther away, probably no more than a few tens of feet at the most, the rates will approximate the seasonal shifting of sediments to which many of the organisms are adapted, and with increasing distance from the trench, increasing numbers of the organisms will survive until there is no appreciable effect. Thus, the immediate impact will be significant along the pipeline route and the adjacent areas where the spoil is deposited.
>
> The effects of redistributing material by trenching from the reducing zone at depths below the seafloor into an oxidizing environment on the seafloor is probably negligible (General Oceanographics, 1971b).

Since the bottoms undergoing jetting are soft, recovery is anticipated to be rapid, with most of the species having even limited mobility to recolonize the disturbed areas within months. This recovery rate is based on the assumption that the sediments are relatively unpolluted and jetting will not stir up toxic substances within the sediments.

Impacts Associated with Blasting. Bedrock and cobbles are exposed or present within the top three feet of sediment between the inner edge of the kelp bed and the beach. Blasting would be required to bury the pipe through this zone. Two main effects of blasting are anticipated. The first is related to the pressure (shock) wave created by the explosion. Fish and mammals with internal air spaces (e.g., lungs and air bladders) can be killed or injured by the shock wave. The range of this effect is dependent on the weight, type, and placement of the charge (Hubbs and Rechnitzer, 1952). Bottom-living fish seem to have a better chance of survival than pelagic forms. The second effect is associated with the movement of substrate out of the blast site by the force of the explosion. Animals and plants in the immediate vicinity of the blast would, presumably, be killed outright. Biota further away from the explosion would be covered with debris; survival in this region would depend upon the ability of the organisms to dig their way out (in the case of motile species or clear themselves of sediment. The blasts would also raise a cloud of sediment. The impact of this cloud would be qualitatively comparable to that of the jetting spoils.

The adverse impact of the shock wave could be mitigated to some extent by a propitious choice of explosives. Fish are evidently more affected by an instantaneous shock wave of the type produced by dynamite than by a fluctuating wave produced by slow burning explosives such as black powder (Cole, 1948). Therefore, in order to minimize the loss of fish and mammals in the blasted area, the slowest burning type of explosive available to adequately do the job should be employed. Because blasting involves effects of both shock waves and debris redistribution, its short term adverse effects influence a wider diversity of organisms and are generally more detrimental than those of jetting.

Recovery on the soft bottoms affected by blasting will be similar to that of jetting, but recovery on hard bottoms will require more time because settlement of larvae will be required. The composition and relative abundance of the species may be changed to some degree because of the larvae of the former species may not settle first. The community structure may require several years to return to the original species composition if it does at all. The question of succession in the marine environment is still debated (see Section II.F.2 and POCS Reference Paper II.F.2 for a discussion of kelp bed succession). In contrast to most of the species of the upper canopy, many species of the holdfasts and seafloor have relatively long lives and may require several years to reach sexual maturity.

Impacts Associated with Rip-Rap Installation. The alternative to burying the pipeline in the inshore regions is to lay the pipe on the surface and securely anchor it in place with a cover of rip-rap (rock, concrete blocks or concrete bags). Where the pipeline and rip-rap are placed on the bottom, epifauna, such as sea stars, brittle stars, and sea urchins, may be crushed, but infauna (animals living in sediments) would be relatively little affected. If the pipe and rip-rap were laid on the surface of the kelp bed, existing kelp plants and other organisms in a very narrow zone along the route would be killed. However, rip-rap, independent of the material utilized, would soon (probably within a year) be colonized by the characteristic fauna and flora naturally inhabiting permanent substrate in the area. Recent studies indicate that fish usually concentrate around artificial underwater structures (Turner, et al., 1969) and the rip-rap reef should be no exception. Besides providing additional habitat for game fish such as kelp bass and calico bass, the rip-rap should be especially attractive to abalone and lobsters because of the abundance of cavities.

The areal impact due to jetting would be limited to less than 40 m of bottom, while that of blasting would be only slightly larger, the exact distance being hard to predict. The time for the area to recover biologically would depend upon the time required for the destroyed sessile associates to reach sexual maturity and reproduce. Kelp require one to two years to mature. The time required for the sessile associates to reproduce will depend upon the individual species and will vary from months to several years.

Pipeline installation may stir sediments containing pollutants which may cause mortalities and/or food chain accumulation at several locations along the coast.

Santa Barbara Channel Area. The mainland portion of this region extends from approximately Point Agruello to the middle of Santa Monica Bay and includes shoreline segments 27 through 32 on the oil spill model. The Northern Channel Islands, San Miguel, Santa Rosa, Santa Cruz and Anacapa also line the channel on the south side. For a discussion of the probabilities of oil reaching these areas refer to Section III.C.1.b and the discussion on the intertidal impacts. As depicted in Visual No. 2, most of the mainland coast from Point Conception to Rincon Point (shore segments 29 through 32) is protected with extensive kelp beds. This is the part of the Channel which has a relatively low probability of being oiled. Extensive kelp beds also occur around Point Dume, an area which has a higher probability of being oiled.

As summarized above, little evidence exists that kelp is harmed by oil. Large beds protect the coastal intertidal areas from oil impacts. Under extremely heavy repeated oilings, the reproductive biology of kelp may be interfered with but this is speculative. The expected impact will be the mortality of many canopy associates which range from invertebrates through fish. Particularly susceptible are probably the microcrustacea, particularly mysids. Because of the rapid reproductive rate and short life cycle, the population of most of these associates should return to prespill levels within a year.

The impact from an estimated additional 6 small spills (from 5 to 1,000 barrels) is difficult to predict because of the great range in the volume and the uncertainty of the time spread between these spills. Six spills of around 50 barrels spread over wide periods will have no noticeable impacts, but 6 spills of nearly 1,000 barrels occurring within as many years can have a very harmful effect on canopy species, particularly if they are combined with a large spill which all go to the same area. The use of dispersents could either increase the impact or decrease it depending upon the type used. Recently developed dispersents, which are essentially non-toxic and applied offshore so the suspension remains within the water column, if used may lead to a decrease in the suspected mortality of the canopy associates. Since so much of this problem is unknown to begin with, comments on the value of non-toxic dispersent use is fairly speculative. The same generalizations may be applied to the Channel Islands, northern coasts, which are, except for Santa Cruz, about 80 percent protected by kelp.

The situation becomes more optimistic when one considers the accessibility of oil containment equipment. With such equipment on the platforms and the already-operational group Clean Seas serving the Santa Barbara Channel area, nearly all spills will be encountered before reaching shore. The efficiency of the system will significantly decrease the amount of oil reaching shore (see Section III.A.4.b), although during high seas or a large spill not all oil will be contained.

Pipeline dredging has been discussed above. These impacts will not occur at Ventura where the pipeline is proposed to go ashore, but may affect the kelp area by turbidity. No detrimental impacts are anticipated from turbidity, however.

<u>San Pedro to Dana Point</u>. This coastal region (shoreline segments 24-26) contains only a small portion of kelp beds (see Visual No. 2). The oil spill model predicts a relatively low probability for this area of the coast receiving oil from a spill as the result of

Sale No. 48. The impacts to the kelp and their associates are expected to be similar to that described above for Santa Barbara Channel.

The proposed pipeline into Los Angeles-Long Beach Harbor will not cross any kelp bed areas.

The oil containment group responsible for oil spills south of Point Dume is SC-PCO which is rather new and less experienced than its counterpart in the north, but will be able to significantly decrease the probability of oil reaching shore in this and the San Pedro Bay area. However, the same precaution in high seas and large spills mentioned in the Santa Barbara Channel area apply here.

Dana Point to San Diego Area Impacts. This area of the coast has extensive though scattered kelp beds, including the large recently recovered area off Point Loma, near San Diego. The probability of oil reaching the kelp beds is low (Section II.C.1.b Intertidal Impacts) and the impacts will be similar to those described under Santa Barbara Channel Impacts.

Santa Rosa Area Impacts. The majority of the southern coast of the Northern Channel Islands are protected by kelp beds. As indicated in the discussion of impacts on intertidal areas (Section III.C.1.b) the oil spill model predicts a low probability of an oil spill reaching these islands during the life of lease activities.

If a spill does reach the kelp areas, the impacts are expected to be similar to those summarized in the Santa Barbara Channel Lease area.

Tanner-Cortes Banks Area Impacts. No impacts on kelp in any coastal area are expected to occur from the Tanner-Cortes Banks lease area.

Santa Barbara Island Area Impacts. Santa Barbara Island is nearly completely fringed by kelp beds. Any large spill reaching this island will oil some kelp and canopy associates. According to the oil spill model, however, Santa Barbara Island has a very low probability of receiving oil as a result of Sale No. 48 (Section III.C.1.g). If oil should reach the kelp beds of this island, the impacts will be similar to those summarized for the Santa Barbara Channel area.

San Nicolas Island. About 75 percent of San Nicolas Island is fringed by kelp (Visual No. 2). The probability, according to the oil spill model, of a spill reaching San Nicholas Island, particularly within three days, is very low (Section III.C.1.b). If oil should reach the kelp beds, the impacts will be similar to those summarized for the Santa Barbara Channel area.

The Southern Islands. According to Visual No. 2, Santa Catalina Island is fringed by numerous small kelp beds over much of its shoreline with a large gap on the northern and southeastern shores. San Clemente Island is fringed by large kelp beds over about 80-percent of its shoreline. The oil spill model indicates a low probability for oil to reach the kelp beds of these islands within three days for both islands and within 10 days for San Clemente Island.

If oil should reach the kelp beds of these islands, the impacts will be similar to those summarized for the Santa Barbara Channel area.

Baja California Impacts. If one assumes that any segment predicted by the oil spill model as having less than 5-percent chance of receiving oil from a spill over the life of the lease as being insignificant, none of the mainland of Baja will be impacted as the result of Sale No. 48. This applies as well to the islands.

Point Conception to Point Reyes Impacts. The oil spill model predicts that as a result of tankering none of the seashore segments have a significant probability (greater than 5 percent) of receiving oil from a large (greater than 1,000 barrel) spill as the result of Sale No. 48. For a discussion of this area, see cumulative impacts below.

Cumulative Impacts: The oil spill model and expected number of spills data indicate essentially no difference between spill probabilities for Sale No. 48 and cumulative operations for many areas within the proposed lease area. These areas will be omitted from this discussion.

The area having the largest difference in the potential impacts as the result of the cumulation of other activities is the Santa Barbara Channel area. Since, as outlined above, the only significant impact predicted from "normal" spills during Sale No. 48 activities is mortality of canopy associates, many of which recover within a year, we cannot predict further cumulative damage even if a spill occurs every other year until the year 2000.

Even though the only significant impact which can be predicted from inferences in the literature is mortality of canopy associates, many which recover within a year, the outcome from the 10 (9.63) expected large oil spills and 19 (18.78) expected small spills cannot be predicted. In the first place, the size range of the small spills varies from essentially no impact (50 barrels) to a possibility of mortality of some significance (1,000 barrels) to the canopy species. Further, the time spread between the 29 spills can vary, from widely separated small impacts, to the possibility of several spills over

several years, all striking the kelp beds of a single island (particularly, Santa Cruz), although the probability of this case is probably small, it is unknown, the impacts could be severe and last for a number of years.

Will there be any long range decrease in kelp population resulting from the destruction of gametes or other reproductive life forms? Again, the question of endemic species remains unanswered.

The San Pedro to Dana Point area also has significant differences between potential cumulative and Sale No. 48 impacts.

Much the same can be said about this area as was summarized under Santa Barbara Channel Area Cumulative Impacts, particularly the unpredictability of the impact of the small spills (14.56) expected for this area. Some consideration might be given to the recovering kelp beds off Palos Verdes and the general deterioration of the environment around this area (Fay, 1972, POCS Reference Paper III.B and others). It would appear there are more serious problems around the Los Angeles area and the addition of some oil spills to certain parts of this area would be insignificant to the artificial recolonization of a kelp area.

It is interesting that the oil spill model does not predict a greater than 5-percent probability of a spill reaching a shoreline segment of Baja (No. 20) nor one of its islands (Los Coronados Islands) until 30 days after the spill. Even then the probability is low, 8 percent at both areas. The impacts on the kelp beds of this region will be similar to those summarized for the Santa Barbara Channel area.

According to the oil spill model the shoreline sections just south of San Francisco Bay (No. 42 and 43) have some probability of receiving oil within 10 days after a spill (11 percent and 8 percent), so they will be considered here. According to Figure II.F.2-1 only about 5 percent of these areas are protected by kelp. The species is different than Southern California, being the bull kelp *Nereocystis luetkeana*. The overall impacts described for the giant kelp of Southern California will be apparent here although, since it is less well developed, the impact on the canopy community should be less.

Little evidence exists that kelp is harmed by oil. Large beds protect the coastal intertidal areas from oil impacts. Under extremely heavy repeated oilings, the reproductive biology of kelp may be interfered with but this is speculative. The expected impact will be the mortality of may canopy associates which range from invertebrates through fish. Particularly susceptible are probably the microcrustacea, especially mysids. Because of the rapid reproductive rate and short life cycle, the population of most of these associates should return to prespill levels within a year.

The possibility of the extinction of endemic species from the Santa Barbara Channel where the oil spill model predicts the possibility of frequent spills remains essentially unknown.

h. Impact on Estuaries, Bays, and Marshes: Estuaries, bays, and marshes are critically important biologically. Estuaries are not as large or numerous in Southern California as they are in some other portions of the United States. Much of the estuarine environment has been severely altered or destroyed. It is essential, therefore, to preserve the remaining unaltered areas if species dependent upon these estuaries for breeding, nursery areas or during their entire life cycle are to survive in Southern California.

The intertidal organisms reported killed during the Santa Barbara blowout were able to repopulate the impacted intertidal because of large populations at surrounding noneffected areas (Straughan, 1971). More rare species with a very narrow and limited reproductive range could conceivably have become eliminated from the Southern California region. Because of their rareness, a smiliar situation is possible with certain estuarine species. Several species use bays for nursery areas (California halibut and Pacific staghorn sculpin (see Section III.F and POCS Reference Paper III.D). Other species, both invertebrates and vertebrates, are important permanent residents of bays (Ho, 1974). Further destruction of estuaries in Southern California will increase the probability that estuarine affiliated species will be entirely eliminated from the coast because of the elimination of nursery grounds and habitat destruction.

No drilling operations will be conducted in estuaries as the result of Sale No. 48, nor are pipeline routes anticipated to cross an estuary. (The latter would cause significant alterations in the path of the pipelines.) The potential impacts on bays and estuaries resulting from Sale No. 48 would come from oil spills.

No oil spills have reached semi-enclosed bays in California, although Foster (1974) reported massive mortalities in the Santa Barbara Harbor during the 1969 blowout. Scientific evidence for impacts on estuarine communities must come from other areas where the environment is somewhat different. Another variable which makes comparison difficult is that studies of most accidental spills which have impacted an estuary have involved more toxic refined oils rather than crude oils. This presents extreme impacts which, in reality, may be less severe in estuaries oiled by crude oil. According to Bender, et al., (1977) and others, however, severe impacts have been documentated when crude oil is spilled on estuarine habitats.

Impacts on phytoplankton and zooplankton are covered in more detail in Section III.C.1.a.

Studies of the toxicity and physiological effects on phytoplankton have shown oil can cause mortality, delayed cell division (asexual reproduction) and both inhibition and stimulation of primary productivity. Of special significance to zooplankton is the usually greater sensitivity

that the drifting planktonic larval forms of fish, benthic invertebrates and possibly certain dispersal stages of macrophytes have to petroleum hydrocarbons. According to Moore and Dwyer (1974) early life stages may suffer mortality at concentrations of one to three orders of magnitude less than that toxic to adults.

Factors operating to minimize effects on plankton are the fact that fractions of oil in the water column disperse rapidly so concentrations are usually very low and the rapid regeneration rates typical of most plankton (Mitchael, 1977).

Seminatural estuarine habitat studies can provide good indications of oil impacts under actual spill conditions. Bieri and Stamoudis (1977) reported massive plankton mortalities within minutes after No. 2 fuel oil was spilled on the water surface, while Bender, et al., (1977) reported a decrease in primary productivity followed by a stimulation over normal and a return to normal primary productivity within 7 days after weathered and non-weathered crude had been placed on the water.

Salt marsh flats are important components of the estuarine ecosystem providing food, shelter, and breeding areas for community members.

Baker (1971) reported most marsh seed plants recovered from light single dose coverage by crude oil although leaves were killed, eliminating primary productivity until the following season. Heavy pollution was more damaging when there was enough oil to soak into the ground around the bases of plants and kill their growing points, causing mortality of the plant. Penetration of oil into the substratum has direct effects by spreading around root systems and reducing normal bacterial activity or oxygen content. This smothers the shoots of plants such as *Spartina* which pass oxygen into the soil via their roots.

The effects of oil spilled on estuarine marshes of the east coast where *Spartina* is very important has been studied by Hampson and Moul (1977), Thomas (1977), Vandermeulen (1977), and Bender, et al., (1977).

Although concentrating on the dominant plant of the intertidal area, *Spartina alterniflora*, Hampson and Moul also reported that the plants *Salicornia* sp. and *Limonium* sp., which occur at slightly lower vertical levels of the intertidal, were affected by having their leaves killed when covered with No. 2 fuel oil. Species of these genera are important members of salt marsh flats in California (see Section II.F and POCS Reference Paper No. III.D).

Oil, once in sediments can remain for years, its residence time and resulting impact depending upon the wave energy, type of substrate and vegetative cover, and type of oil. When substrate is heavily oiled, erosion can be increased 24 times. Population densities may continue to decrease for several years before recovery commences. It required two

years for *Spartina* to turn around at Chedabucto Bay from a Bunker C spill, according to Vandermeulen (1977).

According to Hampson and Moul, the areas of the intertidal where the substrate was comprized of peat absorbed oil in far greater amounts, with a greater residence time than where the substrate contained significant amounts of sand. This caused more extensive and longer lasting mortality. The community has not been able to reestablish itself by rhizome sprouting or seed germination in the three years since the spill.

The peat substrate apparently does not occur, or is very rare, in estuaries in California, but the algal mat-succulent component of the community reported in Tijuana Bay by Zedler, et al., (1978) may serve as a trap for oil.

Since the intertidal and subtidal benthic community has such an important role in the overall ecology of an estuary (Carriker, 1967), any event which destroys a large proportion of this community will have a significant effect on other communities in the bay, such as fishes and birds. The literature clearly indicates that the bottom community of shallow areas having limited circulation and wave energy, such as semi-enclosed estuaries, suffer the greatest impact from oil contamination (Blumer, et al., 1970a, b; Sanders, 1977; Sanders, et al., 1972; Michael, et al., 1975; North, et al., 1967; Vandermeulen 1977; and others).

Perhaps the most famous of these is the West Falmouth spill in Buzzard's Bay which involved No. 2 fuel oil. The spill provided a unique opportunity for a study of the immediate and long-term effects of an oil spill on an area where the previously existing environmental base was well known (Blumer, et al., 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer, et al., 1970b; Sanders et al., 1972). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer, et al., (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be the source of a chronic pollution problem near that spill.

In 1977, there were still areas that showed the impacts of oil while other areas have completely recovered from any apparent oil impacts (Sanders, 1977). On the areas affected there was a reduction of species down to a single tolerant indicator polychaete worm, *Capitella capitata* or *Medimastus ambiseta*. Many community members settled down on the bottom during the summer breeding season, but were unable to survive. Certain amphipod microcrustaceans of the family, Ampeliscidae, were extremely sensitive to oil. Bay mussels *Mytilus edulis* that survived the spill were in poor condition, with gonads undeveloped during breeding season.

Galtsoff (1959) reported a decrease in the condition of oysters in Louisiana exposed to petroleum hydrocarbons. Anderson (1977) reported a decrease in the condition of the clam *Macoma inquinata* in sediments containing oil.

Much of the reason for the long time that oil impacted the benthos in Buzzards Bay was because of its persistance in sediments. Figure III.C.1.h-1 shows the length of time oil has remained in various marine habitats during various oil spill studies. The fine sediments of a clam flat followed by other sediment habitats retain oil the longest.

Anderson (1977) considered the toxicity of oil on sediments and the mortality and physiology of the estuarine clam *Macoma inquinata* and noted preliminary work indicates a greater amount of oil can be tolerated if in sediments than if it is dissolved or suspended in water. This may be correlated with the greater water solubility of aromatics and their greater toxicity to marine organisms.

In the low energy areas of Chedabucto Bay, Nova Scotia, six years after the Arrow spill involving refined Bunker C oil, populations of the soft shell clam *Mya arenaria* are still decreasing. The population is under stress with physiological activities and recruitment impaired. Vandermuelen (1977) reported n-alkanes were preferentially leached from the sediments, leaving proportionally more toxic aromatic compounds, with a long residence time, largely of unknown composition, and with potential long-term biological implications. In short, the oil found in the 1977 sediments is not the same oil spilled there in 1970.

In contrast to what has been found in other estuarine molluscs, the soft shell clam did not depurate (purge) tissue contaminated by petroleum hydrocarbons in 75 days when transferred to clean sea water.

Due largely to the work of Anderson and Associates at Texas A&M, evidence is increasing which suggests that marine organisms have the ability to depurate accumulated petroleum hydrocarbons. This suggests that the classical food chain buildup does not occur with petroleum hydrocarbons. The fact that the animals tested did accumulate hydrocarbons in rather large quantities indicates that temporary food chain buildup can occur. The naphthalenes remain within the species tested the longest and are also among the most toxic petroleum fractions (Anderson, et al., 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzo-a-pyrene reached high enough concentrations in predators, death or possibly cancer could result. The impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem than if the classical food chain buildup did occur.

Also see Section III.C.1.1 for further information on oil in marine food webs.

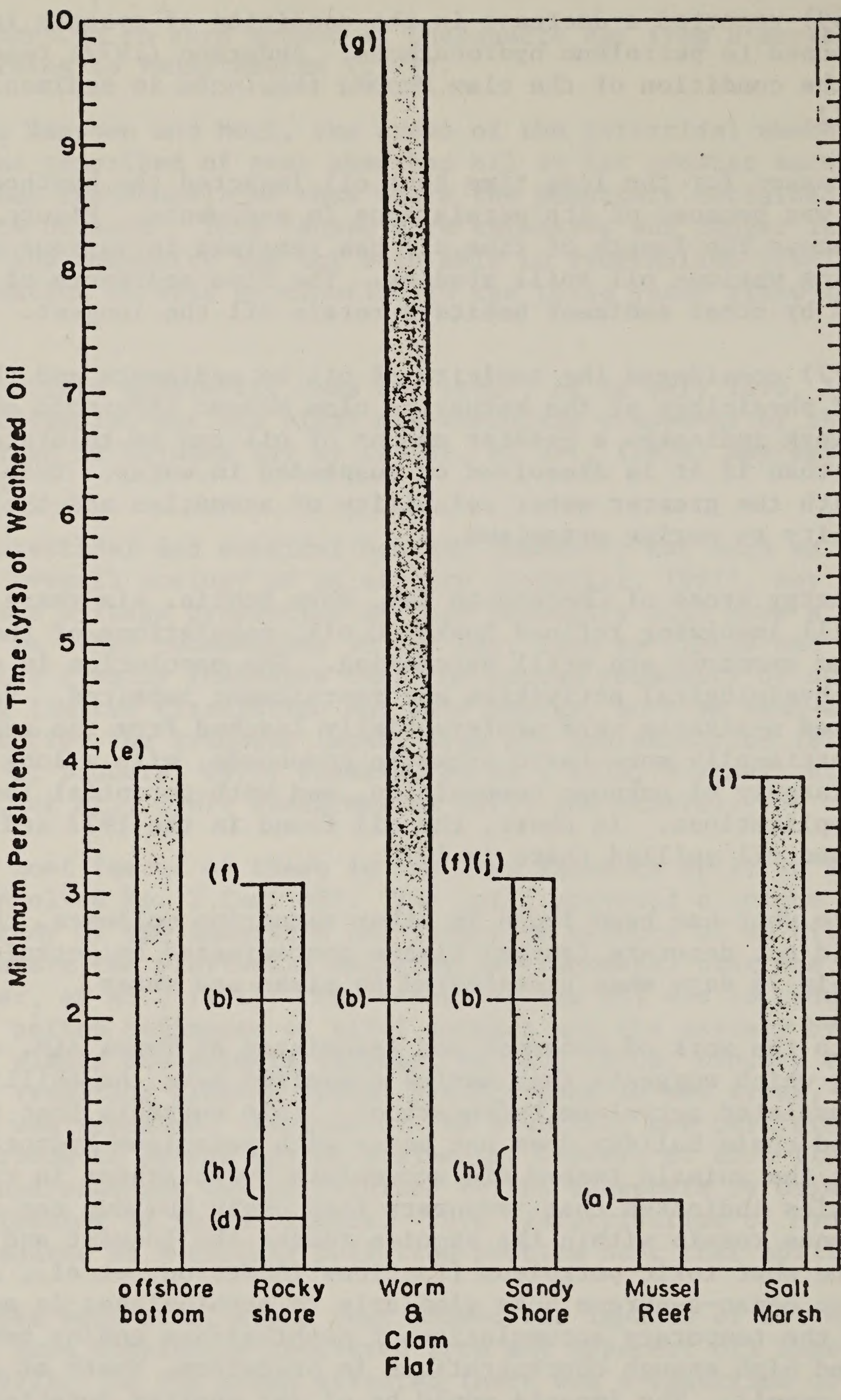


Figure III.C.1.h-1 Observed persistence of petroleum substances in various marine habitats following actual oil spills. Maximum times shown do not necessarily imply complete removal of oil, but may represent author's estimate of persistence or termination of study.
From: CEQ (1974)

Legend for Figure III.C.1.h-1

(a) *Mytilus californianus* were described as having an oil coating after six months; non-lethal effect (Chan, 1973).

(b) Analytical determination of oil (Scarratt and Zitko, 1972).

(c) Author is referring to lagoon, which can be broadly interpreted as a salt marsh (Thomas, 1973).

(d) The authors cite visual evidence of oil retained in rocky ledge by false eel grass for several months (Clark and Finley, 1973).

(e) Author's estimate after two years; analytical methods; used No. 2 fuel (Blumer and Sass, 1972).

(f) Interpretation from statement made by authors; analytical techniques: crude oil (Straughan, 1973).

(g) Visual observation and analytical. JP-5 and No. 2 fuel (Shenton, 1973).

(h) Visual observation--emulsifiers used on crude (Smith, 1968).

(i) Teal, 1973.

(j) Gas-liquid chromatography analysis (Spooner, 1971).

Fish are covered far more extensively in Sections III.C.1.c and III.C.7. Juvenile or egg stages have been found to be more sensitive to environmental stress than adults of many species. It, therefore, stands to reason that fishes utilizing estuaries as breeding or nursery grounds have a higher potential for impact from an oil spill which has entered an estuary.

Permanent residences of the Southern California bays include smelt, *Atherinops affinis*, the California killifish, *Fundulus parvipinnis*, the arrow goby, *Clevelandia ios*, the diamond turbot, *Hypsopsetta guttulata*, and the shiner pearch, *Cymatogaster aggregata*.

Other species utilize estuaries for breeding and nursery grounds but spend their adult life in the coastal oceanic waters where an unsuccessful breeding season could have impacts on the oceanic system as well as the bays impacted. Important seasonal visitors include the California halibut *Paralichthys californicus*, Pacific staghorn sculpin *Leptocottus armatus*, deepbody anchovy *Anchoa compressa*, and an elasmabranch, the gray smoothound *Mustelus californicus*.

Birds utilizing estuaries which could be impacted by an oil spill are covered in Sections III.C.1.d and f.

i. Santa Barbara Channel Area Impacts: The mainland portion of this area extends from approximately Point Arguello to the middle of Santa Monica Bay and includes shoreline segments 27 through 32 on the oil spill model. The Northern Channel Islands are also included in this region, but these, as the other islands of the Bight, have no real bays or estuaries of the kind we are defining in these sections.

Proceeding from west to east, rivers which empty into the ocean or bays connected to it are:

Santa Ynez River	Santa Clara River
Goleta Slough	McGrath Lake
Carpinteria Marsh	Mugu Lagoon

The entrances to the sea of most of these are narrow, and mainly closed, making it difficult for a spill to enter, particularly if booms are available near the entrances. The exception is also the largest and probably most pristine and unaltered: Mugu Lagoon can have an entrance as wide as 800 m during the winter and always has a fairly large entrance to the sea.

The oil spill model predicts that over the life of lease activities there is a relatively good probability that oil will reach the entrance of Mugu Lagoon (see Section III.C.1.b).

Impacts expected for Mugu Lagoon and other Southern California bays are somewhat hard to forecast because most of the historical information comes from other areas of the country and have involved the more toxic fuel oils. In the event of a large spill which completely covers the surface and the flats of the lagoon, the impacts will be severe. If the oil remains on the flats for several days, destruction could be manifested for over 10 years. Some species may be permanently eliminated, if endemic, or until artificially restocked if not.

The impact on plankton will vary from minor and quickly recoverable, if only a small portion of the water surface were oiled, to severe, if the entire surface were covered for several tide cycles. The larvae of benthic species or fish can be decreased so subsequent years will have small populations of the year-class which was oiled.

The important salt marsh would be effectively killed for 6 months to a year from a small coverage, but completely killed for an unknown time (until the sediment becomes non-toxic enough to sustain seed

germination and sexual maturation) if the coverage is heavy and lasts several days.

If oil gets into the sediments, the impact could last for several years. However, with the comparatively less toxicity of crude oil and the weathering which will have occurred by the time it reaches the bay, it is hard to predict the severity, and particularly the length of the impact.

Recovery from a severe spill if most species have been eliminated could involve a successional sequence where preclimax species occupy a habitat temporarily out-competing the climax species. This could cause recovery to take longer than ordinarily would be required.

Dispersents will greatly decrease the impact if they are applied before they reach the estuary.

The largest deterrent to oil spill impacts of an estuary, given one occurs, is to prevent it from entering the estuary. The methodology is available to prevent nearly all oil from entering these bays except during extremely stormy conditions and possibly at Mugu Lagoon during the winter when the entrance is at its widest.

ii. San Pedro to Dana Point Impacts: This coastal area is composed of shoreline segments 24 through 26 and includes the following rivers and bays:

Ballona Creek-Marina Del Rey	Lower and Upper Newport Bay
Anaheim Bay	Santa Ana River
Bolsa Chica Bay	

Much the same situation applies here as was written about the Santa Barbara Area. The narrow entrance to the sea makes it relatively simple to protect the bays from oil spills.

Both Upper Newport Bay and Anaheim Bay are relatively unaltered and care should be taken to protect them from oil coverage. This will be simple with Upper Newport Bay because a spill would have to travel the entire length of Lower Newport Bay to reach it. In addition to being one of the very few relatively unaltered estuaries remaining in Southern California, Anaheim Bay has an additional distinction of having a very rare cephalocaridean (microcrustacean) which is very valuable from a scientific and evolutionary standpoint (see III.F.1 and POCS Reference Paper III.D). It's loss would deprive science of the opportunity to determine how more modern crustaceans acquired the characteristics which makes them, in terms of both numbers and species, to be the most successful and important animals in the ocean.

iii. Dana Point to San Diego Impacts: This area consists of the oil spill model coastal segments 23 through 21 and includes the following rivers and estuaries which have communication with the ocean:

Santa Margarita River	Del Mar Lagoon
San Dieguito River	Los Penasquitos Lagoon
Buena Vista Lagoon	Mission Bay
Agua Hedionda Lagoon	San Diego Bay
Batiquitos Lagoon	Tijuana Lagoon
San Elijo Lagoon	

The entrances of these rivers and bays (except San Diego Bay) are narrow and it would be relatively easy to prevent oil from entering.

Most of the lagoons mentioned above are already altered by human activity. The exception is Tijuana Lagoon which is apparently in a more natural state than the other two coastal relatively unaltered estuaries, Mugu Lagoon and Anaheim Bay.

The oil spill model predicts a low probability of having oil reaching these segments of the coast, but if one did and entered an estuary the impacts are expected to be similar as those described above in the Santa Barbara Channel area.

As indicated in Section III.C.1.b, the oil spill model does not predict a high probability of a spill reaching Baja California or Central California as a result of Sale No. 48, so they will not be covered until cumulative impacts.

<u>Cumulative Impacts</u>. The oil spill model and expected number of spills data indicate essentially no difference between spill probabilities for Sale No. 48 and cumulative operations for many areas within the proposed lease area. These areas are omitted from this discussion.

The area having the largest difference in the potential impacts as the result of the cumulation of other activities is the Santa Barbara Channel area.

If Mugu Lagoon were severely oiled 10 times within approximately 20 years of oil activity it probably would not be able to recover unless the oiled sediments were dredged and removed. This may be particularly true if the large spills were combined with several of the expected 19 additional small spills of 50 to 999 barrels. We assume this has a very low probability of actually happening even if nothing were done to catch the oil before it entered the lagoon. With the protection that we assume will be taken to protect this lagoon, oil activity need not alter Mugu Lagoon.

The San Pedro to Dana Point area also has significant differences between potential cumulative and Sale No. 48 impacts. Much the same can be said about this area as was summarized under Santa Barbara Channel area cumulative impacts.

The oil spill model predicts that even with cumulative activities, no estuaries of Baja California have a significant (greater than or equal to 5 percent) probability of receiving oil even 30 days after the spill.

According to the oil spill model the shoreline sections just south of San Francisco Bay (Nos. 42 and 43) have some probability of receiving oil within 10 days after the spill.

Sensitive rivers or bays having communication with the sea in these shore segments include Pescadero Creek and San Francisco Bay. Similar impacts as those summarized under the Santa Barbara area are expected. Again, booms and other equipment which will prevent oil from entering the rivers are required to prevent a potential severe impact should an accident cause oil to enter.

The conclusions which can be made on impacts on bays and estuaries resulting from Sale No. 48 depend upon whether a spill reaches an estuary and enters it in large quantities. If it does, tremendous destruction of the biota can be expected. The relative small openings of estuaries in Southern California and the anticipated protective measures make this a small possibility. The exception to this is Mugu Lagoon which has a wide (800 m) opening during certain periods of the year.

i. Channel Islands: Impacts upon marine flora and fauna are discussed in detail in Sections III.C.1.a through h, and in j and k. Therefore, this section will only mention conditions or factors of particular concern around the Channel Islands.

San Nicolas, San Miguel and the western half of Santa Rosa are under the influence of the cold California Current and the marine community is typical of Central California. Santa Cruz, Santa Barbara, Anacapa and the eastern half of Santa Rosa receive both cold California Current water and the warmer counter current water. As a result, the flora and fauna are very diverse and contain many species characteristic of the north and south. Organisms occurring at the limits of their range are generally more sensitive to environmental disturbance than organisms more centrally located within their range. Therefore, the large number of species, for which these islands represent a southern or northern range limit, can be expected to be especially sensitive. That is, the potential impacts of oil spills, drilling effluents, pipeline construction and so on, which are discussed for plankton, benthos, nekton and intertidal organisms, would probably be greater around these islands than in other areas. However, this comment would be less applicable to the two Southern Channel Islands, San Clemente and Santa Catalina, which are bathed primarily by the warm(er) counter current and have typically warm temperature species.

As discussed in II.F.3 the other marine biologically significant characteristics of these islands (in addition to their diversity) are: 1) largest and most diverse temperate water pinniped community in the world (Norris, et al., 1975); 2) location of six of the nine hydrocoral (*Allopora californica*) communities known in Southern California; and 3) location of 40 percent of all the kelp beds in Southern California. Note also, the islands are very important to many species of seabirds. These are discussed in Sections III.C.1.d and III.E.3.

Impacts upon pinnipeds are discussed in detail in III.C.1.3. However, it should be stressed that "major populations of the northern elephant seal (*Mirounga angristerositris*), the California sea lion (*Zalophus californianus*) and the harbor seal (*Phoca vitulina*) pup and breed each year on the rocks and beaches of the Channel Islands. (At this age, infancy, the animals are most vulnerable to oil pollution). In addition, the northern fur seal (*Callorhinus ursinus*) and the stellar sea lion (*Eumetopias jubata*) have the northernmost extension of their breeding range in these islands" (Norris, et al., 1975). The endangered Guadalupe fur seal (*Arctocephalus townsendi*) is also present.

Seals and sea lions are among the most vulnerable of all organisms, to OCS development. Three main types of hazards are introduced: 1) Increased human activity and disturbance, 2) oil pollution and 3) ecosystem contamination.

Increased human activity includes increased ship traffic during geophysical studies, transportation to and from platforms and drilling rigs, barging and tankering of production, air traffic to and from platforms and drilling rigs, pipeline construction and oil spill clean up activities.

These increased activities pose a serious potential threat to seals and sea lions by disrupting reproduction, feeding and the fragile social order in reproductive colonies (Regents, University of California, 1978). Two alternate pipeline routes have been proposed. One would pass Santa Rosa, and Santa Cruz. The other would pass Anacapa as well. If such pipelines are constructed every effort should be made to time construction so that breeding seasons are not impacted.

Oil on the water or beaches can affect pinnipeds by fouling of fur, ingestion, inhalation and by irritation of eyes and membranes. Fur seals depend on their under fur for insulation Kooyman (in Gentry, Johnson and Holt, 1976) found that application of crude oil to fur seal pelts and captive live animals increased heat conduction 1.7 to 2.0 times and that the metabolic rate of oiled animals was 1.5 times that of controls. Such heat loss could easily be fatal. Smith and Geraci (1974) conducted a crude oil immersion study of seals which resulted in 100 percent mortality after 70 minutes of the test.

Oil can be ingested by young during suckling and by adults during normal feeding. Few studies have been done on the physiological effects of oil ingestion, but it has been shown to blister the alimentary canal (Regents University of California, 1976).

Eye damage can be severe. Nelson-Smith (1973) reported "...after the <u>ARROW</u> spill in Nova Scotia young grey seals were found blundering about in the woods half a mile from shore, unable to find their way back because of oil around their eyes and nostrils...." Pearce (1970) reported blinding of a female seal during a fuel oil spill. Smith and Geraci (1974) exposed seals during a 24 hour field test and all developed eye disturbances characterized by blinking, squinting or closing of the eyelids, lacrimation and conjunctivitis with swollen nictating membranes. There were also corneal errosions and ulcers.

The following is taken from Regents University of California (1976). Shortly after the 1969 platform blowout in Santa Barbara Channel,

biologists determined percentage mortality for northern elephant seal and California sea lion pups, percentage oil-fouled, and tagged oily and clean living pups (Le Boeuf 1971; Brownell and Le Boeuf 1971). It was determined that significantly more dead California sea lion pups were oil-fouled than living pups; however, no cause-and-effect relationship could be postulated from the scant data. Northern elephant seal pups, perhaps, fared somewhat better, in spite of the fact that the blowout occurred during the breeding season. Tag returns showed that oily pups survived as well as clean pups. Because the oil contamination occurred after the pups were weaned, they fortunately did not ingest oil as they suckled from their mothers. Had the blowout occurred two weeks earlier, the impact might have been severe. An oil spill that contaminated a gray seal rookery in Wales resulted in significantly lower peak weight of oiled pups and a very high overall mortality (both oily and clean pups) (Davis and Anderson 1976). Though the high pup mortality was apparently related to oil clean-up activities with accompanying disturbance, stress, and disruption of the social structure, the ultimate survival of the smaller, oily pups remains in question.

Ecosystem contamination with its consequent effects on the food chain is discussed in III.C.1.k. It should be pointed out here, however, that there is much evidence that the productivity of colonial breeding animals, like seals and sea lions is limited by the availability of food and that the location of these colonies is closely tied to foraging areas. The proposed development in and near many of these foraging areas has important implications.

The most probable pipeline routes will not impact any known hydrocoral communities around the islands. Other OCS activities should not affect the hydrocoral communities around the islands, although those communities on Tanner and Cortes Banks probably would be impacted.

The large kelp beds around the Channel Islands should not be affected by routine operations resulting from the sale. Placement of drilling structures, onshore production platforms, and so on would all be outside the areas in which the kelp beds occur. The distance between the kelp beds and potential drill sites would be more than three miles in most cases so drilling discharges should not have any effect. However, an oil spill would be expected to reach the kelp beds (see Table III.C.1.i-1). The large brown algaes which form the bulk of the kelp beds are very resistant to oil because of a natural mucus covering (Anderson, et al., 1969). Other investigators report damage to other algal species ranging from slight to none, except in intertidal areas where plants were completely covered. Ebling, et al., (1971) reported only slight damage to associated organisms in the kelp bed. The above remarks should be considered in the light that more information is needed on the energetics and

Table III.C.1.i-1

PROBABILITY OF CONTACT BY ONE OR MORE 1000 BBL SPILLS
BETWEEN 1979 AND 2000

Island	3 Days			10 Days			30 Days			60 Days		
	P	E	B	P	E	B	P	E	B	P	E	B
San Miguel	6%	6%	12%	11%	18%	27%	14%	23%	34%	14%	25%	36%
Santa Rosa	10	20	27	15	33	44	18	37	48	19	38	50
Santa Cruz	37	53	71	50	71	86	53	75	88	53	75	88
Anacapa	12	25	34	20	40	52	23	43	56	23	44	56
San Nicolas	3	6	9	6	10	16	10	18	26	12	21	31
Santa Barbara	<0.5	<0.5	1	2	4	6	4	8	12	5	9	14
Santa Catalina	2	3	6	13	21	32	20	32	45	22	33	48
San Clemente	<0.5	<0.5	<0.5	2	4	6	11	21	30	16	23	40

P = Proposed Leases; E = Existing leases; B = Both

interrelationships in kelp beds before oil spill impacts can be discounted as potential threats. Pipeline construction would have the most obvious impacts on the beds. Jetting, blasting, rip-rap installation would destroy the kelp beds in a narrow band along the pipeline corridor. Recovery, including associated organisms, would be expected to take several years.

What are the chances that oil will reach the islands? POCS Reference Paper No. VI analyses oil spill probabilities from the proposed sale and from existing leases. Three different modes of transporting production are analyzed. Table III.C.1.i-1 assumes that the mixed A method of Reference Paper No. 6 is used. This is a combination of tankering and pipelines and is believed to be the most likely. The probabilities, in percent, that one or more spills greater than 1000 barrels in size will contact the islands, within different time periods, are presented. The time period is 1979 to 2000.

The analysis does not give information on the amounts of oil that would arrive (some would have evaporated, sunk, dispersed); it simply shows that contact would occur with that degree of certainty. Also, the condition of the oil is not discussed. Evaporation and weathering naturally help to detoxify crude oil. Most of the toxic aromatic fractions are gone within three days, greatly reducing many potential impacts. Note, however, that many of the potential impacts on seals and sea lions (discussed in this section) will not be significantly dimminished by weathering of the oil. The reduced quantities, 40-60 percent of most crude oil slicks evaporate within 24 hours, would greatly reduce impacts. Containment measures and dispersants would further reduce impacts. Additionally, the most important pinniped communities are on San Miguel where the probability of an oil contact is fairly low, 6 percent. Nevertheless, with the high probabilities of oil spills reaching the islands and the large pinniped communities living there, it is almost a certainty that some of these animals will be injured or killed by oil pollution during the life of the project.

Table III.C.1.i-1 shows clearly that existing leases are more likely to cause oil pollution in the islands than the proposed leases. For example, the probability at least one, 1000 bbl spill will reach Santa Cruz within three days (from existing leases) is 53 percent. The proposed leases will increase this probability by 18 percent, to 71 percent. At Santa Catalina the probability is increased from 3 percent (existing leases) to 6 percent with the addition of the proposed leases.

Other existing oil pollution sources are Alaskan and foreign oil being tankered to Southern California. The risk from these tankers is greater than from the proposed sale. The probabilities that one or more 1000 bbl spills will occur and hit land between Pt. Reyes and punta Eugenia) is 72 percent within 3 days, 92 percent for 10 days, 98 percent for 30 days and 99 percent for 60 days. The most

likely number of times these spills will occur and hit land within 3, 10, 30 and 60 days are 1, 2, 4 and 5 times. Corresponding numbers of spills for the proposed lease are 1, 2, 3 and 3, for a hit within 3, 10, 30 and 60 days.

Because of prohibitions against oil and gas related onshore development of the Channel Islands, no onshore impacts are anticipated from this sale.

j. Impact on Unique Biological Environments: Section II.F.5, Unique Biological Environments, identifies 67 separate areas and 4 subareas between Point Reyes and Punta Eugenia. Potential impacts upon these areas will be discussed by treating the Southern California Bight first, Baja California, then Central California.

i. Southern California Bight

Ecological Reserves and Marine Life Refuges. There are 7 Ecological Reserves and 9 Marine Life Refuges in the Bight. The Reserves and Refuges in the Bight are discussed together.

Impacts from increased human activity and boat and air traffic will be negligible. All the Reserves and Refuges in the Bight are near high density urban areas except Farnsworth Bank, off the windward side of Santa Catalina Island. This area is far removed from the proposed lease areas and not within potential boat traffic corridors that might be established to service the lease areas. Platform placement, pipeline construction, routine mud and cutting discharges will also have a negligible impact on all these areas. The proposed pipeline routes are located many miles from most of the Reserves and Refuges, and the closest platforms would be at least 3 miles away. Except for Farnsworth Bank Ecological Reserve, all the Reserves/Refuges in the Bight are already seriously affected by the enormous quantities of industrial and private sewage that is dumped into the Bight, more than 979 million gallons daily (see Section II.H.2.). Of this total discharge, 48,384 gallons per day are oil and grease. The standard discharges resulting from the wells in the proposed sale area would not be a significant addition to the existing effluent load. At Farnsworth Bank, water quality stresses are much less than along the mainland coast. However, the distance from Farnsworth Bank to the proposed tracks should safeguard this Reserve from degradation resulting from routine drilling operations.

The most significant potential threat to these Reserves/Refuges is from an oil spill. POCS Reference Paper No. VI shows that there is a 99 percent probability of at least one 1,000 bbls spill during the life of the project. The most probable number is 5 spills. The probability of one of these spills reaching a land segment containing a Reserve or Refuge depends upon the method of transporting production to shore (see Tables 5A, B, and C, POCS Reference Paper No. VI). Table 5B represents the most likely transportation scenario. Table III.C.1.j-1 shows the probabilities of a spill reaching a particular segment, assuming the spill does occur from a particular area.

Table III.C.1.j-1

PROBABILITY OF 1 OR MORE SPILLS GREATER THAN 1,000 BBL HITTING SEGMENT FROM FROM PROPOSED LEASE TRACTS (MIXED A TRANSPORTATION)

Land Segment Number Contains	From All Tracts Within			Highest Prob. from Adj. Tracts Assuming a Spill		
	3 Days	10 Days	30 Days	3 Days	10 Days	30 Days
21) Pt. Loma R.; San Diego-La Jolla E.R.*; San Diego M.L. Ref.*	1%	3%	7%	7%	17%	23%
22) Buena Vista Lagoon E.R.	<0.5%	2%	4%	5%	15%	19%
24) Heisler Park E.R.*; Newport Beach M.L. Ref.*; Irvine Coast M.L. Ref.*; Laguna Beach M.L. Ref.; S. Laguna Beach M.L. Ref.; Niguel M.L. Ref.; Dana Pt. M.L. Ref.; Doheny Beach M.L. Ref.	<0.5%	1%	1%	3%	5%	6%
25) Bolsa Chica E.R.; Pt. Fermin M.L. Ref.	3%	5%	6%	6%	9%	10%
26) Abalone Cove E.R.	11%	20%	22%	1%	5%	6%
53) Farnsworth Bank E.R.	2%	13%	20%	<0.5%	7%	11%

R = Reserve; ER = Ecological Reserve; ML Ref = Marine Life Refuge; * = Area of Special Biological Significance.

The values in Table III.C.1.j-1 do not consider quantities or qualities of the oil that arrives. That is, after 2 days, 40 to 60 percent of the oil has evaporated and the toxicity of the remainder is greatly reduced. Oil spill cleanup is not taken into consideration, either.

In summary, the probabilities of more than 500 bbls of oil reaching any of the areas is low, except for Abalone Cove Ecological Reserve and Farnsworth Bank Ecological Reserve. The shallowest point on Farnsworth Bank is over 20 m (65 feet) deep. Pinnipeds and sea birds are not known to utilize the area for feeding. Therefore, the potential impacts from an oil spill are less than in the other areas discussed. Further consideration of the restricted openings to some of these areas (Buena Vista Lagoon Ecological Reserve, Newport Beach Marine Life Refuge, Bolsa Chica Ecological Reserve) make it reasonable to assume that the proposed sale has a low probability of seriously impacting any of the Reserves or Refuges in the Bight.

<u>Areas of Special Biological Significance (ASBS)</u>. Some of the Reserves and Refuges discussed above are also ASBS. Those marked with an * in Table III.G.1.j-1 are ASBS's and, as discussed above, it seems unlikely that any of these will be seriously impacted. However, some of the other ASBS's in the Bight are quite likely to be impacted deleteriously. All of the Channel Islands have been designated ASBS's. Impacts upon the islands are discussed in Section III.C.1.i. The high probabilities of spills hitting the islands, the presence of large numbers of very sensitive species such as sea birds, seals, sea lions and lush intertidal communities virtually assures that there will be some injuries and fatalities to these sensitive creatures/communities. The impacts and recovery periods are discussed in detail in Sections III.C.1 and III.E.

<u>Unique Biological Areas</u>. Four areas in the Bight are listed as unique: 1) San Miguel Island, 2) San Nicolas Island (north end), 3) Tanner Bank and Cortes Bank, and 4) Castle Rock (San Clemente Island).

San Miguel Island is considered unique because it is the focal point of the largest temperate water pinniped (seals, sea lions) community in the world, haulout area for some endangered Guadalupe fur seals and supports a rich association of algae, invertebrates and fish. Impacts on San Miguel's resources have already been discussed in Sections III.C.1.b, c, e, f, and g. They could be minor to severe.

San Nicolas Island is considered unique because of unusually large, deep tide pools containing very rich floral and faunal associations. These pools are located at the north end of the island. Of the wide range of effects from OCS development, such as increased human disturbance, boat traffic, mud and cuttings discharges, and so on, only one poses a potential threat to San Nicolas - oil pollution. Distances from proposed leases and pipelines effectively mitigate all other potential impacts.

POCS Reference Paper No. VI shows that the overall probabilities of 1 or more oil spills reaching the island within 3, 10 and 30 days are 3 percent, 6 percent and 10 percent. This assumes Mixed A transportation, tankers and pipelines. The probabilities that a spill will reach San Nicolas, given that it occurs, from existing adjacent tracts, proposed tracts and proposed pipelines is shown in Table III.C.1.j-2.

Table III.C.1.j-2

PROBABILITY THAT GIVEN A SPILL IT WILL
REACH SAN NICOLAS WITHIN 3, 10, AND 30 DAYS

Launch Point	3 Days	10 Days	30 Days
Proposed Santa Rosa Tracts	4%	16%	18%
Proposed Santa Barbara Tracts	<.5%	1%	5%
Existing Santa Rosa Tracts	7%	16%	20%
Existing Santa Barbara I. Tracts	<.5%	5%	9%
Proposed Pipeline "A"[a]	8%	10%	11%
Proposed Pipeline "N"[a]	12%	20%	23%

[a]This is the same pipeline. "A" indicates the portion adjacent to San Nicolas; "N" indicates the segment northwest of the island.

The northwest end of the island which contains the unique biological area is partially protected on all sides by more than a mile of shallow water and thick kelp beds. These kelp beds would trap much of the oil. However, there is a great deal of variability in these kelp beds, and extensive losses of kelp area often occur.

Any oil reaching these tide pools would have a devastating effect. Anderson, et al., (1969), Blumer, et al., (1971), Chan (1973), Sander (1973) and many other researchers have documented the effects of oil in intertidal areas. Oiling of these tide pools could result in the smothering of many species such as limpets and acorn barnacles. Much of the oil could be permanently trapped in the pools, adhering to the sides. High mortality of abalones, clams, mussels, star fish, and sea urchins would occur. Some of the highly mobile organisms such as fish and crabs could escape, but many could be trapped and die. Marine vegetation could be seriously impacted, also. The oil would damage cell membranes, reduce photosynthesis and translocation (Chan 1975, Nelson-Smith, 1973). Plants coated with oil would be heavier and would probably be torn loose in the surge of passing waves. In summary, the immediate effects (if oil reached the area) would be that the tide pools could be seriously

impacted, with most organisms being killed within a short period of time. Recolonization would be slow. Nelson-Smith (1971) has shown that fish seem to avoid contaminated areas. The same is probably true of many invertebrate species. Within 3 to 5 years, the pools would probably be largely recovered (Mitchell, et al., 1970). However, it could be much longer, more than 10 years, before the original community structure was restored. For a more detailed discussion of intertidal impacts, see Section III.

The proposed OCS development can impact the unique resources of Tanner Bank and Cortes Bank (see Section II.F.5) in numerous ways. Potential impacts are classed as heavy, moderate or minor in Table III.C.1.j-3.

In summary, Tanner Bank and Cortes Bank will continue to support all the "resources" listed in the table. However, it is very probable that the community structure will change. The total numbers of many species which live on or utilize the banks could decrease significantly. These species include: hydrocoral (*Allopora californica*), ringed top shells, abalone, blue rockfish, sheephead, giant sea bass, California sea lions, Northern fur seals, elephant seals, gulls, terns, alcids, jaegers, sheerwaters, and storm petrels.

Biologically Sensitive Areas. Seven areas are listed for the Bight, in addition to those already discussed under Reserves, Refuges, ASBS's and unique biological areas. Impacts in these areas would be primarily from oil spills. The probabilities that oil would reach one of these areas in 1 to 30 days are small. Assuming the most likely combination of pipelines and tankers (Mix A of Reference Paper No. VI) the probability of oil, from all the proposed tracts reaching Point Conception is 4 percent - 3 percent for all the other areas. Only slightly higher probabilities are obtained by assuming that 3.1 spills, of 1,000 bbls or more, result from the proposed Santa Barbara leases, pipelines and tanker routes (Refer to Section III.A.4 for detail.) Multiplying 3.1 x (the sum of the probabilities that given a spill from the different launch points, a hit will occur with a particular probability) and dividing by the number of launch points gives the probability of a segment being hit from all the launch points in an area. This assumes there is an equal probability of a spill from each launch point. The values are 5.7 percent for Burmah Beach, Goleta Slough, Goleta Rocks and the Standard Oil Pier at Carpinteria, 5.1 percent for the Santa Clara River mouth and Carpinteria marsh, and 4.2 percent for the Point Conception area. Therefore, even assuming these high rates of spill occurrence, these particular resources are in a low risk category. Also, the three most sensitive areas, Goleta Slough, Carpinteria marsh and the Santa Clara River mouth have restricted access to the sea, making them much easier to protect from an oil spill. Note that proposed pipelines come ashore near the Santa Clara River mouth. Great care should be taken not to cross or disrupt this area during pipeline construction.

Table III.C.1.j-3

IMPACTS ON TANNER AND CORTES BANKS

Resource	Major Causes of Impacts on Tanner and Cortes Banks: Mooring Equip.	[a]Traffic Boat, Air	Mud Cuttings	Prod. Plat.	Pipe-Lines	Oil Spill Other[b]	Oil Spill TC[c]	Cumulative Of All
H = Potentially Heavy[d], M = Potentially Moderate, Min = Potentially Minor, T = Tanner, C = Cortes								
1) Exceptional abundance of organisms (TC)	M	Min	M	M	M	M	M	M
2) Hydrocoral communities (TC)	M	Min	M	H	H	Min	Min	H
3) Unusual assemblage of organisms (TC)	M	Min	M	M	M	M	M	H
4) Pinniped feeding (TC)	Min	M	Min	M	Min	H	H	H
5) Sea bird feeding (TC)	Min	Min	Min	Min	Min	H	H	H
6) Monoplacophorans (TC)	Min	Min	Min	Min	Min	Min	Min	Min
7) Giant sea bass (TC)	Min	Min	Min	M	M	Min	M	M
8) Lobsters (C)	Min	Min	Min	Min	Min	Min	M	Min
9) Abalone (C)	Min	Min	Min	Min	Min	Min	M	Min
10) Cowries (T)	Min	Min	M	Min	Min	Min	M	Min
11) Sheephead (T)	Min	Min	Min	Min	Min	Min	M	Min

[a]Includes potential impacts from bilge pumping, sewage, etc. from boats.
[b]Spills from tracts other than Tanner and Cortes.
[c]Spills from tracts on Tanner and Cortes.
[d]The percent of the population injured, displaced or destroyed is: heavy 16-30, moderate 6-15, minor 5 percent or less.

ii. Mexico - Biologically Sensitive Areas: Because of the distances between the proposed activities and these Mexican resources, potential impacts will be confined to those resulting from oil spills. The probabilities of 1 or more spills occurring and contacting these resources within 10 days is less than 0.5 percent, except for Islas de Los Coronados. The probability here is only 1 percent.

Within a time period of 10 days, the oil will have undergone many chemical changes which reduce its toxicity. Evaporation would reduce the volume, also. The subtidal resources in these biologically sensitive areas would probably not be impacted by anything but a major spill, more than 100,000 gallons. The other resources would be much more sensitive. Sea bird rookeries occur on all the islands in this area. Even weathered, "detoxified" oil causes serious impacts upon birds. It removes the anti-wetting agent, matts feathers, clogs the nasal passages, and irritates the eyes. Prevailing currents will drive most spills in the proposed lease area southward toward these islands where sea birds could be killed. The numbers lost would depend upon the volume of oil involved. In addition to supporting large sea bird rookeries, these islands are very important to elephant seals *Mirounga angustirostris* and the endangered Guadalupe fur seal *Arctocephalus townsendi*. Like birds, these pinnipeds are very vulnerable to oil contamination. Mortalities could occur, the number being dependent upon spill size. Under proper conditions, a large spill (35,000 bbl), from the southern tracts, might very substantially reduce the Guadalupe fur seal population and seriously reduce the elephant seal and sea bird populations.

iii. Tankering Leg (Point Conception to Point Reyes): Seven Reserves, 3 Refuges and 5 sensitive biological areas are located in this area. All potential impacts in this region would be from oil spills. POCS Reference Paper No. VI shows the probabilities of oil reaching the land segments containing these resources. Probabilities for a contact, within 30 days, are very low: 1%, <0.5%, <0.5%, 1%, 2%, 3%, 2%, 2%, 4%, <0.5%, <0.5%, <0.5% for the 12 land segments. These values, coupled with a consideration of the resources themselves, make it unlikely that significant deleterious impacts will result from the proposed sale.

Cumulative Impacts. The cumulative impacts of proposed Sale No. 48, coupled with existing offshore oil production, Alaskan tankering, foreign tankering, outfall discharges and other existing projects, show a serious, continuing degradation of nearly all environmental parameters in the Bight. Note, however, that most potential Sale No. 48 impacts in most of the proposed lease areas are small compared to environmental stresses already taking place. The cumulative impacts for this section are summarized in Table III.C.1.j-4. The impacts are the averaged impacts for each resource category. Individual areas could vary, from more to less serious.

Table III.C.1.j-4

POTENTIAL IMPACTS ON UNIQUE AREAS

Resource	Potential Impacts: Proposed Sale No. 48	Existing Bight Projects	Cumulative
Bight			
Ecological Reserves	Min	M	M
Marine Life Refuges	Min	M	M
Mainland ASBS	Min	M	M
Channel Is. ASBS	M	H	H
Unique Bio. Areas	M	M	H
Bio. Sensitive Areas	Min	M	M
Mexico			
Bio. Sensitive Areas	Min	M	M
Central California			
Ecological Reserves	Min	Min	Min
Marine Life Refuges	Min	Min	Min
ASBS	Min	Min	Min
Bio. Sensitive Areas	Min	Min	Min

Percentages are the percent of the marine population injured, destroyed or displaced. Min = Minor (5 percent or less), M = Moderate (6-15 percent), H = Heavy (16-30 percent).

Nearshore mainland areas in nearly all of the Bight have been seriously altered. Santa Monica Bay and the San Pedro Shelf are the most grossly disturbed. The proposed sale is very unlikely to significantly worsen this situation. Ongoing projects place much greater stress on these areas than the reasonable potential stresses from proposed Sale No. 48.

k. Impact on the Marine Food Web

i. Petroleum Hydrocarbons

The majority of this summary was taken from the summary papers by Anders, et al., (1974) and the National Academy of Science (1975).

Introduction. Hydrocarbons, organic compounds containing carbons and hydrogen, are universal components of the marine environment. Marine hydrocarbons originate from a variety of sources, including biogenic decay and metabolism, natural seepage of petroleum, and petroleum pollution from accidents in transportation, drilling, and production of fossil fuels. Hydrocarbons can be divided into biogenic hydrocarbons, (hydrocarbons native to organisms), and petroleum hydrocarbons (hydrocarbons found in fossil fuels). Distinguishing characteristics of petroleum hydrocarbons from biogenic hydrocarbons include the following: 1) a much greater range of molecular structures and weights of the more complex mixtures of hydrocarbons; 2) approximate unity ratio for even- and odd-numbered homologous series, such as alkanes; 3) more kinds of cycloalkanes and aromatic hydrocarbons; and 4) numerous naphthenoaromatic hydrocarbons in petroleum that have not been reported in organisms (Anderson, et al., 1974).

Uptake, Metabolism, and Discharge. Petroleum hydrocarbons are available to marine organisms in various physical and chemical forms, and the resultant uptake by organisms is dependent on the available form and the degree of the exposure, including the amount and duration. As petroleum is dispersed and modified, it is presented to pelagic organisms in dissolved, dispersed, or suspended forms, and the benthic organisms in dissolved, dispersed, suspended, or sedimented forms (NAS, 1975).

Petroleum hydrocarbons (PHC) may enter the food web by two methods. The first method involves the active uptake of dissolved or dispersed petroleum, mainly via the gills and possibly through the soft body surface of marine worms. The other method involves the passage of PHC into the gut from the water column and/or the water surface while drinking or gulping water, and from ingestion of PHC absorbed on particles, including living and dead matter. The relative importance of the methods is still largely unknown, and probably will vary according to the species, the method of feeding and respiration of the organism, the type of habitat, the sea state, and the physical and chemical form of the petroleum, according to Anderson, et al., (1974). Preliminary evidence indicates that the majority of hydrocarbons enter molluscs, crustaceans, and fish via gill membranes. However, recent work by Corner, et al., (1976) with

copepods suggest that dietary intake is the major route, and that ingested hydrocarbons are retained longer.

Upon entering the organism, PHC can be either passed through the organism as feces or can become incorporated into the body tissues. A significant amount of PHC is taken up and accumulated, at least temporarily, within the body tissues of most fish and invertebrates as a result of an oil spill. Though the relative amount of accumulation varies greatly with the organisms involved and with the concentration and composition of the hydrocarbons, the actual amount accumulated, on a dry weight basis, can be quite substantial, on the order of 5 orders of magnitude, according to Di Salvo, et al., (1975).

Hydrocarbons are usually concentrated or stored in association with biogenic lipids. Specific sites of hydrocarbon storage in some marine animals include muscle tissue, gall bladder, brain and other neural tissues, and liver of fish; gills and digestive gland, or hepatopancreas of shrimp; adductor muscles of oysters; mantle, digestive tract, adductor muscle, and gonads of scallops and mussels; and muscle tissue and digestive tract of periwinkles, sea urchins, and other intertidal benthos.

Anderson and co-workers (1974) report that little information is available on the metabolic pathways of hydrocarbon degradation in marine organisms. Degradation of aromatic and paraffinic hydrocarbons has been reported in marine fish and some marine invertebrates. Phytoplankton and marine invertebrates, including some zooplankton and molluscs, are unable to oxidize either paraffinic or aromatic hydrocarbons. The liver, or the liver-like organ is some invertebrates, the hepatopancreas, is assumed to be the site of hydrocarbon degradation. In these organs, the unaltered hydrocarbons undergo chemical detoxification. In those invertebrates where degradation does not occur, some of the detoxifying enzymes in the hepatopancreas may be missing.

The ability of organisms to depurate accumulated hydrocarbons is a controversial issue. Cell division and the resulting dilution of PHC within cells may be an important method in unicellular algae (Kanas, et al., 1973). Copepods, barnacle larvae, and other zooplankton have been found to discharge oil in fecal pellets, passing the oil apparently unchanged into fecal matter.

The present data indicate that there may be two forms of hydrocarbon accumulation in bivalve molluscs and other organisms: 1) A short-term form where PHC are taken rapidly and depurated completely or to background levels within a range of several weeks to two months (Lee and Benson, 1973; Anderson, 1973; Anderson, et al., 1974a); 2) A long-term hydrocarbon burden accumulated in tissues that is not

completely discharged (Blumer, et al., 1970a; Blumer and Sass, 1972; Lee, et al., 1972a,b; Stegeman and Teal, 1973; Clark and Finley, 1974; Di Salvo, et al., 1975; Lee, 1975; Corner, et al., 1976). Because they apparently have the ability to break down hydrocarbons, shrimp, fish, and marine mammals would probably not retain the residual hydrocarbon concentration as do molluscs.

The avenues of depuration of accumulated hydrocarbons vary. In molluscs and certain zooplankton which can not degrade hydrocarbons, bile salts or some other natural detergents are able to emulsify hydrocarbons and allow passage through the gut, and into the feces. On the gills, molluscs can also connect oil drops with mucous, discharging the material as pseudofeces without passing the oil through the gut (Alyakrinskaya, 1966). Fish use enzymes to form water soluble products from the hydrocarbons, discharging the hydrocarbons probably in the urine, via the gall bladder and kidney. In marine mammals, hydrocarbons are also converted to water soluble products that go through the bile and into the feces and urine. The avenue for the discharge of hydrocarbons by the lobster and related invertebrates has not been determined (NAS, 1975).

The microbial degradation of fossil hydrocarbons and derivatives in the marine environment has been widely reported. However, the rates vary with the chemical complexity of the crude, the microbial population, and many of the environmental conditions, such as temperature, oxygen levels, and microbial predators. The process of "seeding and/or fertilization" of oil spills to facilitate biodegradation has been suggested as a clean-up method, however, the possibilities have not been fully explored (Midget, 1973). A multiseed stock would probably be necessary, and at present, is not technically feasible on open waters or beaches. (NAS, 1975).

Carcinogenicity and Synergistic Effects. Some doubt remains as the direct carcinogenicity of crude oil and crude oil residues. Polynuclear aromatic (PNA) hydrocarbons, some of which are known carcinogens, such as 3,4-benzpyrene, phenanthrene, and chrysene, have been reported in petroleum and petroleum products, but concentration levels of PNA from crude oil or concentration levels in the water column after an oil spill are unknown (NAS, 1975). Conclusions regarding the effects of oil and carcinogens in the marine environment are based on limited information. Recent work has implicated crude oil as a carcinogen, but further research is needed in the field of carcinogens and man's exposure to them (Ehrhardt, 1972; NAS, 1975).

Synergistic effects of oil and other pollutants are not well understood. Immersion studies of seals in oil have shown that non-stressed seals, immersed in crude oil, exhibited only transient eye problems and minor kidney and possibly liver lesions; no permanent

damage was observed. However, seals, stressed by captivity, died within 71 minutes after immersion in oil (Geraci and Smith, 1976). The synergistic interaction of petroleum hydrocarbons and polychlorobiphenols may result in severe, adverse effects on marine populations (Harvey, et al., (1974)). However, as indicated under carcinogenicity, this is an area that needs more research.

Food Web Magnification. The possibility exists of some selective hydrocarbon buildup in the food web, especially by molluscs, which retain a portion of the toxic aromatic hydrocarbons. However, evidence suggests that classical food web magnification (an increasing concentration of hydrocarbons per weight of tissue or lipid at successively higher trophic levels) of petroleum hydrocarbons does not occur. The lower trophic levels, including phytoplankton and zooplankton, can accumulate hydrocarbons. The higher trophic levels, such as fish and mammals, have been found to depurate accumulated hydrocarbons. Therefore, food web magnification may more likely be a function of the ability of different species to accumulate and depurate hydrocarbons from the water and food rather than a function of their position in the food web (NAS, 1975).

Little work has been conducted on hydrocarbon accumulation in sea birds. Grau, et al., (MS) reported Bunker C oil ingested by Japanese Quail (Coturnix coturnix) reduced egg production and interfered with embryonic development resulting in poor hatchability. According to Michael (1977), the ingestion of oil as oiled birds attempt to preen disturbs digestive processes, and a small amount taken internally can cause death. This could be a source of hydrocarbons into the food web through scavengers of bird carcasses.

Public Health Effects. Crude oil and crude oil residues have been implicated as possible carcinogens. Oil contamination could pose problems to human health, if contaminated sea food were consumed. According to the National Academy of Sciences (NAS, 1975) workshop on petroleum in the marine environment, tentative conclusions are:

> Although our information is limited, the effect of oil contamination on human health appears not to be a cause for alarm. From our calculations, we estimate that the carcinogen benzoapyrene concentration on a dry weight basis arising from a high level of contamination by petroleum is comparable with that of common terrestrial foods. We, of course, do not recommend eating contaminated seafood, but in most cases, because of the taste factor, not many will be tempted to do so. It is clear that this is an area in which our knowledge is grossly inadequate and that the contamination of seafood by oil is clearly undesirable.

However, recent work by Dr. P. Yevich of the National Marine Water Quality Laboratory in Narragansett, Rhode Island, has further implicated petroleum as a carcinogen. During two oil spills involving a No. 2 fuel oil and a No. 5 diesel oil, he found two types of cancer formed in soft shell clams. One type forms in gonadal tissue and quickly spreads to other organs; while the other is a blood cell form (Yevich and Barszcz, 1976).

ii. Heavy Metals: Heavy metals occur naturally in sea water in relatively low concentrations. In the coastal zone, especially in estuaries, near river mouths or municipal discharges, concentrations may be much greater than natural background levels. Fourteen trace metals are known to be essential for animal life. They serve as components of enzymes, enzyme system, activators, components of vitamins, hormones and respiratory pigments.

In offshore operations, petroleum, formation waters and drilling muds may contribute heavy metals and other trace elements. Concentrations in crude oil vary greatly. Nickel and vanadium are generally the most abundant metallic elements in crude oil, although cobalt, mercury, iron, and zinc can be abundant. Nickel and vanadium are known to occur in several colloidal materials covering broad molecular-weight and polarity ranges (Filby and Shah, 1971).

The International Decade of Oceanographic Exploration Workshop (1972) concluded that with the possible exception of lead, current levels of heavy metals in marine ecosystems are derived primarily from natural sources. (Natural sources include river water, windblown material from weathered rock and tectonically active ridges where heavy metals are emitted in heavy brine.) In the Gulf of Mexico, the Gulf Universities Research Consortium (1974) concluded that all heavy metals observed in the water column were within ranges reported for oceanic waters, with the possible exception of barium. Once in the marine environment, concentrations of heavy metals are lowered by dilution and removed from sea water by precipitation, absorption and adsorption. Accumulation in marine organisms can occur by uptake and adsorption from sea water through gills, body surface or gut wall. The amount adsorbed depends on many physical characteristics, as well as biological characteristics of the adsorbing organism. Accumulation can also occur through ingestion of food containing heavy metals. Food sources for accumulation of heavy metals include those adsorbed onto suspended particles or plankton, heavy metal compounds that have precipitated into sediments and have been ingested by deposit feeders, and heavy metals concentrated by organisms, which are then preyed upon by other organisms in higher levels of the food chain.

Concentration factors in marine organisms (measured against that available directly from the organism's environment) range up to more than one million for the heavy metals (Lowman, et al., 1971).

The relative importance of uptake from water compared to uptake from food is still being studied and is by no means resolved for marine organisms. It probably varies because of factors mentioned above, for different elements and organisms as well as various relative concentrations (NSE/IDOE, 1974).

Heavy metals are usually used in enzyme systems or stored in a particular body tissue, sometimes only temporarily. The storage location depends on the type of metal, form of the metal complex, method of uptake, species of organism and other factors. Storage sites for most organisms include digestive glands, muscle tissues, skeletal tissue and gills Bryan (1971). Most metals of concern from the standpoint of possible contributions from oil and gas operations are a part of the biological catalyst system and include iron, copper, zinc, manganese, and cobalt (nickel, chromium, cadmium, and silver may follow these elements).

There have been few studies to date on the release or depuration of heavy metals from marine organisms to the marine environment. Although data on retention times are scanty, there are indications that metals concentrated in animal tissues are retained at significant concentrations for several months (Anderson, et al., 1974b). Discharge of heavy metals from marine organisms can take place by ion exchange across cell membranes of gill and body surfaces, excretion of heavy metals into the gut and loss of feces, excretion in the urine (Bryan, 1971), and loss by molting exoskeletons that have concentrated heavy metals (Fowler, et al., (1971). All of these processes help an organism to regulate the concentration of heavy metals and other substances accumulated from sea water or food, but the extent and rate of their release is poorly known for heavy metals.

There is ample evidence to indicate that heavy metals accumulate in the marine food web in a variety of organisms at various trophic levels and through a variety of paths of uptake (Lowman, et al., 1971; Anderson, et al., 1974b; NSF/IDOE, 1974). Most of the characteristics of heavy metals in the marine environment favor their magnification in the food web. They are relatively resistant to chemical and biological degradation. However, classical food web magnification is complicated, not only by the various uptake methods, but by the ability of some organisms to release heavy metals back to the marine environment (Anderson, et al., 1974b; Bryan, 1971 and 1973).

There is evidence that heavy metal concentration in petroleum, formation waters and drilling fluids can range from 10 to 105 times the natural background levels of the open ocean (Rittenhouse, et al., 1969). Therefore, events such as accidental massive or chronic oil spills, accidental loss of drilling fluids and the discharge of formation waters can introduce higher loads of heavy metals into the ocean. The introduced metals are then diluted by sea water, precipitated out, adsorbed on particles or other organisms and absorbed by some marine organisms, occurring around drilling platforms for the most part.

Therefore, there could be some uptake of metals, especially by the sessile organisms around the platforms. It is not known to what extent this occurs and to what levels the heavy metals would concentrate in the water column, sediments or marine organisms as a result of petroleum operations. Investigations conducted by GURC (1974) concerning the effects of heavy metals from offshore petroleum operations indicated that concentrations of heavy metals in the water column were within the ranges of the metals in the ocean water, except for barium where the data were inconclusive, and a zinc gradient around the platforms probably due to the decomposition of the sacrificial covering of the platform legs.

2. Impact on Water Quality: Many of the chemical and physical properties transferred to the ocean during phases of oil development and production represent potential water quality hazards. These potential water quality hazards may have an insignificant impact on the water quality or adversely affect the ocean water quality. These potential hazards magnitude are not uneqivocally known. Based on available information, this section provides an estimate of the impact on water quality i.e., change in water quality that will result from the proposed sale. For information about the impact on biology resulting from the change in water quality, precipitated by oil and gas development and production activities, the reader should consult Sections III.C.1.a through III.C.1.k (Impact on the Living Component of the Environment).

Throughout the oil and gas development and operation, debris and bilge pollution may be released into the ocean waters in the Southern California Bight from research vessels, crewboats, tugs, and service and supply boats. Quantities involved should be similar to amounts released from vessels operating in U.S. waters.

Total and estimate sewage discharged for the Santa Barbara Channel area, San Pedro Bay area, Dana Point-San Diego area, Santa Rosa area, Tanner-Cortes area and Santa Barbara Island area are show in Tables III.A-1 through III.A-6. Sewage will be treated in accordance with OCS Order No. 8 as stated in Section III.A.1.c. Treated sewage of this type, which has proper discharge diffusion, should produce a minimum impact on ocean water quality except in the immediate area of sewage discharge. Areas outside the Southern California Bight (Baja California or area north of Point Conception) should not be affected by this action.

To some degree, bottom sediments will be put into suspension during exploration and development drilling by the emplacement of re-entry collars, blowout preventers, drilling platforms and other sea-bottom equipment. The magnitude and extent of resultant turbidity will be dependent on the bottom materials, type and grain size, the prevailing water current and the duration of the activity. Proposed lease areas and areas currently leased should have a short-term impact from resultant temporarily increased turbidity.

Water quality degradation is also affected by suspension of sediment during pipeline construction and burial. The jetting away of the substrate from beneath the pipeline will result in suspension of sediment which may be rich in pollutants. The sediment plume will move away from operations in the direction of the current. The plume can reach proportions of several yards wide and hundreds of yards long if the substrate is muddy. The duration depends on the particulate size, shape, and density of the material suspended and the water's turbulence. Adverse impacts can result when bottom materials are resuspended and pollutants remobilize into the water column. The area to the south of Point Conception should not be affected by this impact. Areas off Baja California that may be affected by this impact would be those waters directly south of the San Diego lease tracts. After construction, pipeline operations will have no effect on the water quality unless an oil leak or accidental spill occurs.

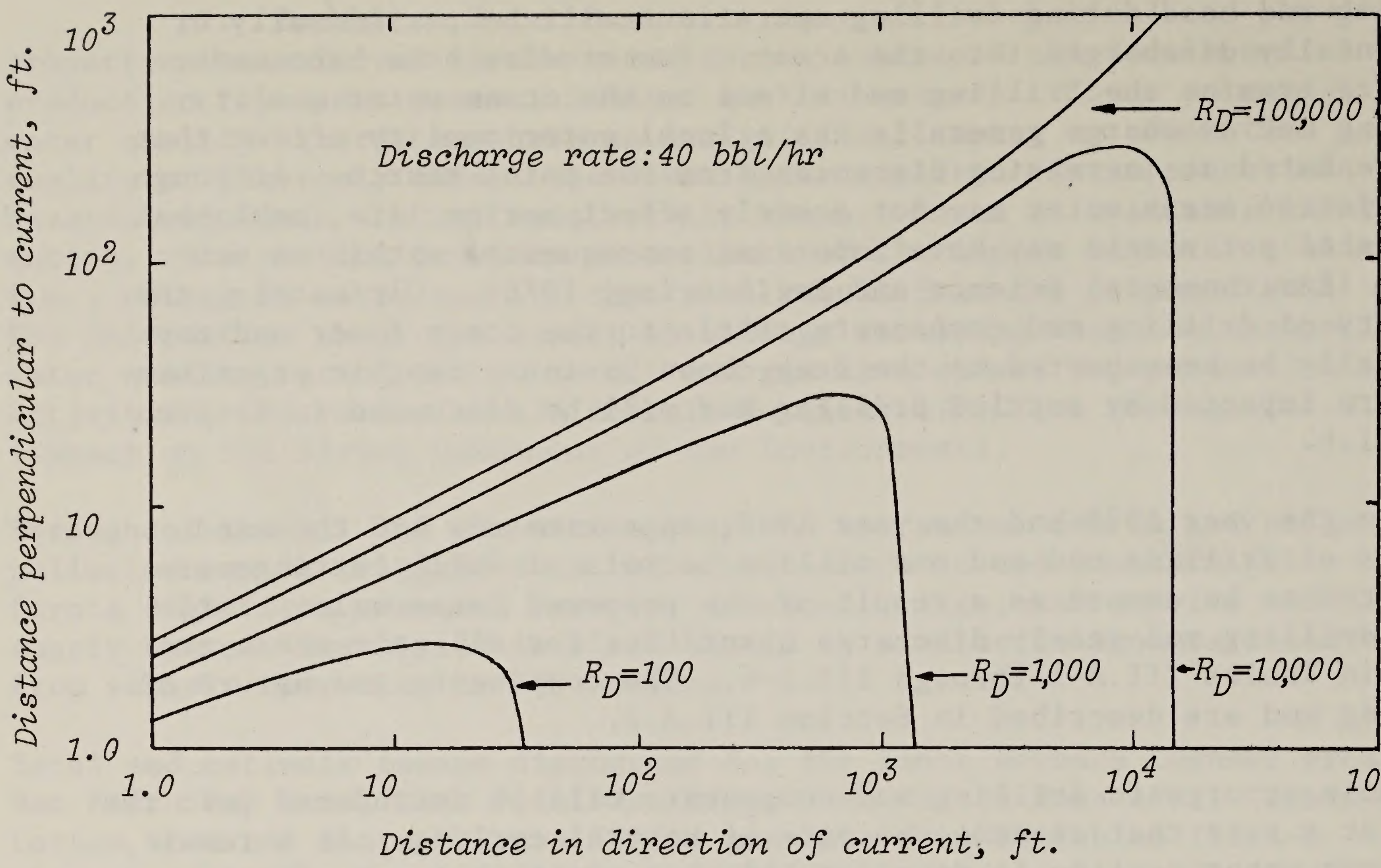
Drilling mud used during drilling operations will be periodically or accidentally discharged into the ocean. Few studies have been undertaken to examine the drilling mud effect on the ocean water quality. Drilling mud discharge generally has a local water quality effect that is attenuated at increasing distances from the point source. Although the affected ocean water may not acutely affect marine life, sublethal effects of pollutants may have important consequences within an ecosystem (Environmental Science and Engineering, 1976). Ultimately, the majority of drilling mud components settle to the ocean floor and may eventually be transported to the deep ocean basins. Benthic organisms that are impacted by settled drilling mud will be discussed in Section III.C.1.b.

Between the year 1979 and the year 1990, approximately 470 thousand barrels of drilling mud and one million barrels of drill cuttings are estimated to be dumped as a result of the proposed lease sale. Estimated drilling mud yearly discharge quantities for all sale areas are given in Tables III.A-1 through III.A-6. The components and nature of drilling mud are described in Section III.A.2.

Inorganic or organic drilling mud components will be introduced into the ocean at a rate that exceeds the rate of natural cycling. As a result, the ocean water quality is deteriorated to a state that may affect marine life health. After discharged drilling, mud and associated drill cuttings settle to the ocean floor and may eventually be transported to the deep ocean floor or basins.

As discharged material settles, associated trace metals may undergo an ion-exchange process affecting movement of dissolved constituents from the drilling mud to the surrounding water column or vice versa. Settling solids from drilling operations may have suspended solids adsorbed on to them, may be adsorbed onto the surface of aquatic organisms, or may be ingested on a source of food.

The discharged drilling mud and cuttings will form a plume that will move away from the point of discharge in the direction of the current. As a result of this plume, the water turbidity will be increased. The dilution of the drilling discharge plume, resulting from drilling mud and drill cutting discharge, is dependent on the type and characteristics of mud used, its discharge rate, the water depth, surface and subsurface currents and ocean physical characteristics. Ray and Shinn (1975) found that drilling fluid 1, discharge at a rate of 40 bbl/hr, may be diluted by 1,000 to 1 (parts ocean water to parts discharged drilling mud fluid) in the direction of the prevailing current approximately 305 m (1,000 feet) from the discharge point. At a discharge rate of 250 bbl/hr the discharged drilling fluid may be diluted by 100 to 1, in the direction of the prevailing current approximately 305 m (1,000 feet) from the discharge point. The dilution ratios presented by Ray and Shinn for steady-state diffusion from a point source with a mixing depth of 75 m (245 feet) and a current speed of 15 cm/sec (0.29 knot) are shown in Figure III.C.2-1.



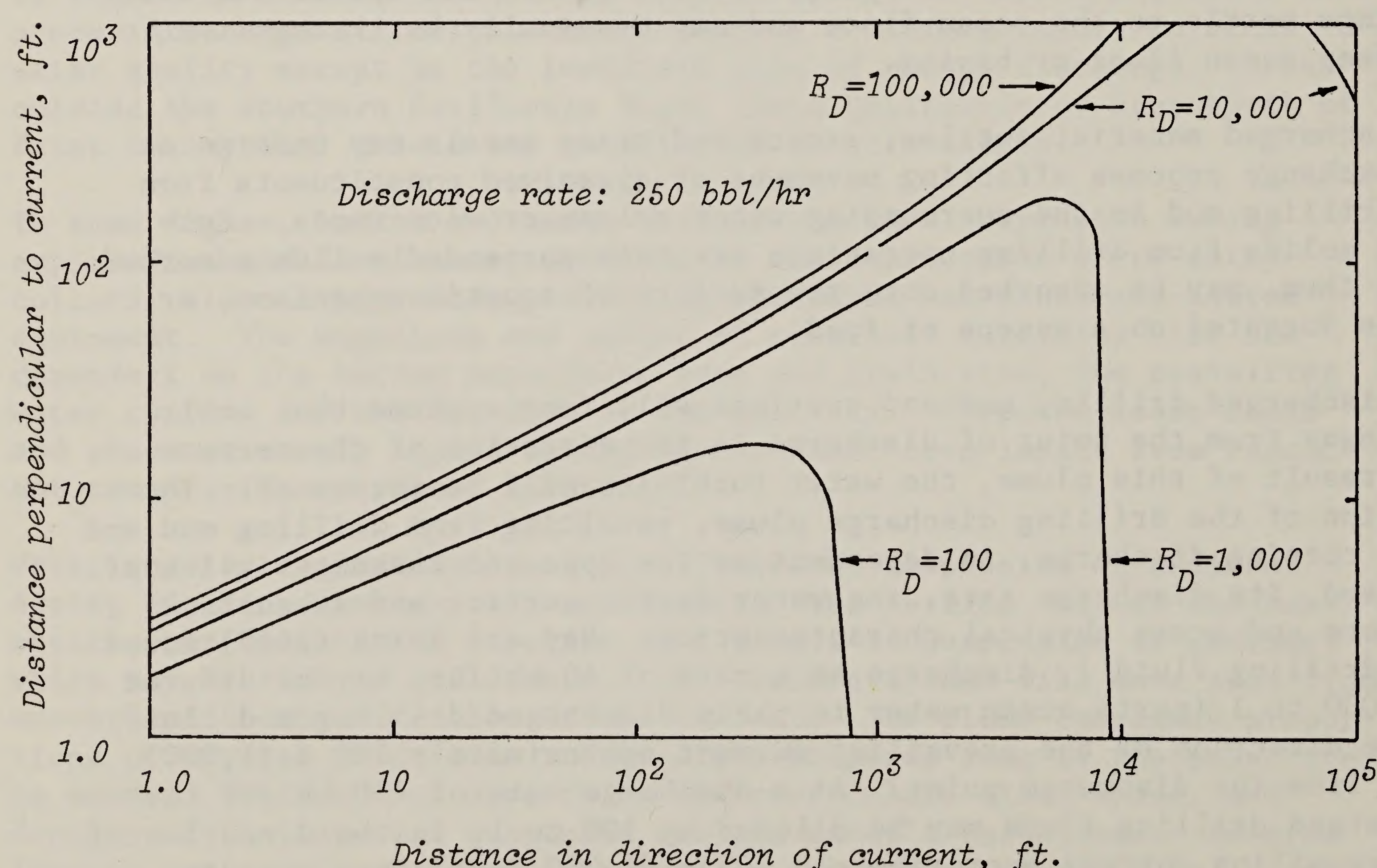


Figure III.C.2-1 Dilution Ratios for Drill Mud Discharged from a Point Source

R_D = Volume sea water divided by discharge fluid.

Source: Ray and Shinn, 1975.

A draft executive report by Shell Oil Company (Study to observe fate and potential effects of discharged drilling mud and cuttings on Tanner Bank, California) describes observed drill mud discharge effects on ambient water conditions and subsequent sedimentation for a discharge rate of 10 barrels/hr. Ambient water conditions are reported for distances less than 200 meters from the point source. Sedimentation resulting from drilling mud discharge is found to be highest within 120 meters from the point source. Although the drilling fluid discharge plume was visual, apparent for a distance of 3-4 km (9,840-13,120 feet), no evidence of elevated sedimentation was reported at a distance of 915 m (3,000 feet) downcurrent from the point source.

Ocean water quality may be degraded by the following drilling mud and cuttings chemical and physical properties:

1) Increased trace metal concentration.

    Barium - used as a weighting material.
    Chromium - used as a dispersant.
    Lead - present in drilling fluids and lubricants.

2) High dissolved oxygen demand.
3) Raised temperature.
4) Increased light attenuation.
5) Reduced hydrogen ion concentration (elevated pH).
6) High concentrations of organic carbon, total nitrogen and phosphorous.

Based on available data, drilling mud and cuttings should have minimal acute effects on the ocean water quality at a distance greater than 1,000 m (3,280 feet). Long-term sublethal effects are possible from chronic discharge of drilling muds and cuttings. At this time no studies were found on sublethal effects of drilling muds and cuttings. The major impact of dumping drilling mud and drill cuttings will be to the bottom organisms. The effect on bottom organisms will be discussed in the appropriate biological section of this report.

The Santa Rosa area, Tanner-Cortes area and Santa Barbara Island area do not receive massive industrial and municipal wastewater mass emission and runoff discharge.

Due to the decrease suspended load in these non-mainland areas, the ocean water quality impact should be higher than the mainland lease areas.

Cumulative barrels of drilling mud and drill cuttings that are estimated to be dumped into the Santa Barbara Channel as a result of this sale and from prior lease sales are approximately 640 thousand barrels of mud and 1300 thousand barrels of drill cuttings. This cumulative material to be dumped into the ocean over the next 12 years will have a short-term

near-field effect on the water quality. In the long run, sublethal effects of the drilling mud may be transferred to the water column as the settled drilling mud is resuspended and transported to the Santa Barbara Basin. Tentative BLM Baseline Study findings indicate that increased concentration of barium and lead are found in age-dated cores taken from this basin. These metals showed an increased concentration corresponding with the years when drilling was initially active in the Santa Barbara Channel.

Cumulative drilling mud and cuttings volumes estimated to be dumped into the San Pedro Bay area, as a result of this proposed sale and the prior lease sale, are approximately 147 thousand barrels of drilling mud and 300 thousand barrels of drill cuttings. This material cumulatively dumped into the ocean will have short-term near-field effects on the ocean water quality. Any long-term residual effects this discharge may have on the ocean water quality should be insignificant with respect to the high amounts of municipal and industrial waste dumped into this area.

No tracts have been leased in the Dana Point-San Diego area prior to this proposed lease sale. Estimated drilling mud (20 thousand barrels) and drill cuttings (40 thousand barrels) to be discharged into this area as a result of this sale will have short-term near-field effects on the water column. Any long-term residual effects the drilling mud or drill cuttings may have on the water quality of this area should be insignificant with respect to the industrial and municipal wastewaters discharged into this area and adjacent areas to the north.

Cumulative drilling mud and drill cuttings volumes estimated to be dumped into the Santa Rosa area, as a result of this sale and tracts leased prior to this sale, are approximately 59 thousand barrels mud and 120 thousand barrels drill cuttings. This material that may be cumulatively dumped into this area over the next 10-12 years will have short-term near-field effects on the ocean water quality. with the low level of anthropogentic pollutants in this area, sublethal drill mud effects may be introduced to the water column as settled drilling mud is resuspended and transported along or off the Santa Rosa Ridge.

The Tanner-Cortes area is approximately 160 km (100 miles) from any land masses that would directly introduce terrigenous material to the ocean. For this reason, any material directly introduced into the area will significantly reduce the ocean water quality of the area. Cumulative barrels of drilling mud and drill cuttings to be dumped into this area, as a result of this sale and tracts lease prior to this sale, are approximately 530 thousand barrels of drilling mud and 1,100 thousand barrels of drill cuttings. Settled drilling mud that is resuspended and transported over the area or into adjacent basins may have a sublethal effect on the water column.

Santa Barbara Island area is about 48 km (30 miles) from Catalina Island and 78 km (49 miles) from the Southern California mainland. Both of these land masses are the only source of terrigenous material for this area. Any material directly discharged to this area will significantly reduce the quality of the ocean water quality of the area. Cumulative barrels of drilling mud and drill cuttings to be discharged into this area are 22 thousand barrels drilling mud and 44 thousand barrels of drill cuttings.

Little ocean water quality deterioration should occur in water above Point Conception or off the coast of Baja California. Any water quality deterioration that may occur in this area should be completely dissipated within several kilometers of the point of entrance.

With the exception of some tracts in the Santa Barbara lease area, discharged formation water resulting from this sale will be from untapped reservoirs. Although untapped reservoir formation water chemical characteristics are not known, an estimate for these formation water chemical characteristics is provided in Table III.A-12.

Formation water discharge estimates for the six lease areas are discussed in Section III.A.1.b and shown in Table III.A-1 through Table III.A-6. The 16-year mean annual and total formation water mass emission rates for each lease area are shown in Tables III.A-13. The yearly value given in Table III.A-11 is a mean value that was calculated over 16 years of production.

Once proven resource production starts, formation water will be discharged into the ocean water. The discharge of these waters into the ocean will alter the chemical constituents of ocean waters. The magnitude that the ocean waters will be altered as the formation water is advected away from the discharge point is questionable. The formation water chemical constituents mass that adsorb onto settling particulate and sink to the ocean floor, rather than being advected by the ocean currents is also questionable.

The main formation water chemical characteristics that will affect ocean water quality are oil or petroleum hydrocarbons, numerous trace elements and an absence of dissolved oxygen. To determine the impact formation water will have on the ocean water quality, the quantitative and qualitative characteristics of formation water need to be known. Additionally, the quality of the ocean waters that surround the discharge point must be evaluated (Table III.C.2-1).

Formation water may be considered to have an impact on the ocean water quality when 1) ocean chemical constituents are raised above ambient condition; or 2) when ocean chemical constituents are increased to a concentration (level) that may have a deleterious effect on marine

Table III.C.2-1

SOUTHERN CALIFORNIA BIGHT AMBIENT TRACE METAL LEVELS AND MAXIMUM TRACE METAL LEVELS THAT PRESENT MINIMAL RISK TO MARINE AQUATIC LIFE

	Southern California Ocean Water				Marine Aquatic Life	
	Ambient Ocean Water Concentration[a] (μg/)[b] Total Trace Metal		Formation Water Dilution Factor[b] Needed to Achieve Ambient Ocean Water Concentrations		Maximum[c] Concentration That Presents Minimal Risk of Deleterious Effects to Marine Aquatic Life[c]	Formation Water Dilution Factor[b] Needed to Assure Minimal Risk to Marine Aquatic Life
Trace Metal	Surface	Deep (about 1,000 m)	Surface	Deep		
Cadmium	0.004-0.015	0.1	100,000	4,400	0.2 μg/l	560
Chromium	0.1-0.2	0.2-0.3	200	19	0.05 mg/l	No dilution needed
Copper	0.08-0.12	0.15	900	600	0.01 mg/l	9
Lead	0.005-0.030	0.03	8,000	4,700	0.01 mg/l	14
Mercury	0.001	N/A	1,250		N/A	
Nickel	0.2	0.5	1,000		2.01 μg/l	100
Silver	<0.01	N/A	30		1.0 μg/l	30
Zinc	0.005-0.050	0.5	60,000	3,300	0.2 μg/l	80

[a]Personal communication - Dr. K. Bruland.
[b]Dilution Factor: Parts ocean water per one part formation water.
[c]National Academy of Sciences - National Academy of Engineering, 1972.

aquatic life. Southern California Bight ambient ocean trace metal levels (surface and deep) and maximum trace metal levels for minimal risk of deleterious effects to marine aquatic life are shown in Table III.C.2-1.

Discharged formation water is dispersed (diluted) as it moves away from the point of discharge. Formation water must be diluted by factors shown in Table III.C.2-1 to obtain ambient ocean conditions or assure minimal risk to aquatic marine life.

Prior to formation water being diluted to non-pollutant levels the effect the formation water has on the marine environment is unknown. While many reports show marine life around a platform are not acutely affected, not considering sublethal effects, a recent report (Environmental Science and Engineering, 1976) has pointed out; "formation water discharges were considered the cause for a series of fish kills that occurred in estuary areas of Long Beach Harbor."

Formation water should have the least impact in the San Pedro area and the Tanner-Cortes area should receive the highest impact. Above Point Conception and off the Baja California coast the formation water effect should be insignificant. In essence, the relative impact, resulting from formation water discharge, should be greatest for those areas that directly receive formation water discharge and are farthest away from current anthropogenic pollution sources.

The chemical constituents mass emission rates resulting from this sale are shown in Table III.A-13. The cumulative mass emission rates resulting from this sale and previous sales are about 2 to 5 times those values given in Table III.A-11.

> (The Santa Barbara Channel area will have cumulative values 3.2 times those given in Table III.A-13. The San Pedro area will have cumulative values 2.8 times those in Table III.A-13. The Dana Point-San Diego area has no previous leased tracts in the area. The Santa Rosa area will have cumulative values 5.4 times those given in Table III.A-13. The Tanner-Cortes area will have cumulative values 3 times those given in Table III.A-13, and the Santa Barbara area will have cumulative values 2.2 times those given in Table III.A-13).

The fate of the discharge formation water is impossible to predict. But previous studies (Chow, et al., 1973, and Bruland, et al., 1974) have shown that various sources of pollutants (winds, sewer outfalls, storm runoff and river runoff) accumulated rapidly in the basins of the Southern California Bight.

Although formation water discharge may be several orders of magnitude lower than those pollutants discharged from industrial and municipal discharges, discharged formation water will add additional pollution to the Southern California Bight.

Water quality may be further degraded as a result of an accidental oil spill[a] or oil leaks to the ocean. While individual chronic low-level oil leaks or spills are not a major source of pollution, large numbers of these chronic leaks represent a significant pollution problem. (Chronic low level spills are discussed in Section III.A.4.a.vi). While chronic spills represent constant insidious pollution to the ocean major oil spills represent the major environmental concern for offshore oil production.

The most lethal period for oil spilled into the ocean is within the first couple of days after an oil spill occurs. It is within this time period that the volatile low molecular weight hydrocarbons are still present. After a couple of days a large portion of the initial spilled oil and some of the more toxic oil components will be evaporated. The amount of oil evaporated within the initial period of the spill may range from 20 percent (Sivadier and Mikolas, 1973) to 50 percent or 60 percent (NAS, 1975), depending on the type of oil spilled. After or during initial evaporation the non-volatile oil acts as a source of pollution, adsorbs onto clay particles, settles to the bottom and remains as a source of pollution, and depletes dissolved oxygen by oxidation of chemical (dissolved gases such as hydrogen sulfide) or biological (petroleum) products. Tests performed on oil to show general toxicity levels by EPA, show that aromatics are the most toxic, nephthenes and olefins are intermediate to toxicity and straight paraffins are the least toxic. Petroleum hydrocarbs may also act as a mobilization mechanism for chlorinated hydrocarbons.

For a more comprehensive description of the fate of oil or weathering of oil, readers should see Section III.A.4.a.vi (Fate of Oil) or Section III.A.4.b.iv (Weathering).

The most probable estimate for major oil spills, within the Southern California Bight, (1,000 barrels or more) resulting from the proposed lease sale is five oil spills. Nineteen oil spills is the most probable cumulative estimate for major oil spills resulting from this sale, previous oil lease sales, and Indonesia oil and Alaska oil tankered into the Southern California area. The cumulative oil spill number is exclusive of oil spills that may result from offshore State oil leases.

---

[a]All information pertaining to oil spill probabilities in this section was taken from the Southern California (Sale 48) Oil Risk Analysis (Pacific OCS Reference Paper No. VI). The reader should consult the reference for more detailed information.

Based on the oil production estimates for Sale No. 48 for the Santa Barbara Channel (SBC) area, the SBC lease sale area may be subjected to three major oil spills. The expected oil spills for the SBC area from Sale No. 48, previous oil lease sales, and tankering through this area are about 10 (9.63 calculated) major oil spills. Thus, the Santa Barbara Channel area will receive 63 percent of the total expected major oil spills resulting from the proposed Sale No. 48 and 51 percent of the total major spill resulting from offshore oil production within the Southern California Bight and tanker traffic in and out of Southern California.

From the oil spill model presented in Pacific OCS Reference Paper No. VI, oil spilled in the Santa Barbara area is found to transverse ocean waters from initial oil spill sites toward the Santa Barbara Channel Island and possibly toward the shores of Santa Barbara within a few days after the spill occurs. Eventually, within 60 days, oil spilled in the Santa Barbara Channel area may spread to ocean water on the Tanner-Cortes Bank area, around San Clemente Island or waters adjacent to Oxnard and Santa Monica. Although the oil may spread (within 60 days) to ocean waters as far south as San Clemente Island or Tanner-Cortes Bank of the most significant impact from a major oil spill in the Santa Barbara Channel to ocean water quality will be within the Santa Barbara Channel.

Although the possibility of one major spill occurring in the San Pedro area as a result of Sale No. 48 is doubtful, five major oil spills are expected in this area as a result of the tanker traffic through the area and the cumulative oil production in the San Pedro area resulting from this proposed sale and the previous oil lease sale. As a result of a major oil spill occurring in this area, oil may be transported to water around Catalina Island or along the mainland coast to Laguna Beach. Spilled oil may be transported to waters off Santa Monica, San Diego or Catalina Island within 10 days after the spill. Thirty days following the spill, oil may be transported 100 km south of the U.S. border. Eventually, (60 days following the oil spill), oil may be transported to water around Cedros Island in the south or to waters around the Channel Islands.

From the San Diego proposed lease area oil resource estimates no major oil spill is expected to occur as a result of this area. There are no oil production sources for this area or tanker through traffic that would create a cumulative impact for this area. If an oil spill occurred as a result of the proposed oil production in this area, oil may significantly affect water to the south of San Diego or the water off Newport Beach within the first three days after the oil spill. Thirty days following an oil spill, oil may be transported to waters off San Pedro and possibly around Santa Rosa Island, San Clemente Island and Catalina Island; or oil may be transported over 200 km (656 feet) south

of the U.S./Mexico border. Eventually (60 days after the spill) spilled oil could be transported to waters off Santa Monica in the north; Point Eugenia in the south; and Tanner-Cortes Bank to the west.

Based on resource estimates for this lease sale, the Santa Rosa area is not expected to have a major oil spill. Additionally, with low resource estimates for the previous lease sale in the Santa Rosa area, and no tanker traffic through this area, no major oil spills are expected in this area from cumulative oil activities. If a major oil spill did occur in the Santa Rosa area, the water quality would be most significantly affected within the first three days of the oil spill. Within this time period oil could be transported to waters around the Santa Rosa Island, Santa Cruz Island, and Anacapa Island or waters on the Tanner-Cortes Banks. Eventually, spilled oil could be transported to waters around San Miguel Island (10 days) or Eugenia Island within 60 days after an oil spill.

In the Tanner-Cortes area one major oil spill is expected as a result of the proposed lease sale. Three or possibly four major oil spills are expected to occur in this area as a result of tanker traffic through the area and cumulative oil production (from previous oil lease sales and this proposed lease sale in the Tanner-Cortes area).

Ocean water in the area of the Tanner-Cortes banks and possibly those waters between San Clemente Island and the Tanner-Cortes Banks would be degraded within the first three days following an oil spill in the Tanner-Cortes area. Oil could further be transported to waters around San Clemente Island within 10 days following the oil spill and possibly, to Cedros Island 30 days after the oil spill. Eventually (60 days after spill) oil could be transported to waters around Catalina Island or San Diego.

From the resource estimates for the proposed Santa Barbara Island lease sale area no major oil spills are expected for this area. Based on the tanker traffic through this area, resource production estimates from previous sales, and this proposed sale, there is a very small chance a major spill will occur in this area. Ocean water which would significantly be affected by an oil spill in the Santa Barbara area (within 3 days of the oil spill), would be those waters around Santa Barbara Island and San Clemente Island. Spilled oil may be further transported to ocean waters around Catalina Island or the Northern Channel Islands within 10 days after an oil spill, and possibly to Cedros Island area 30 days following the initial spill.

Conclusions. The impact of the proposal on water quality is minor over the life of the proposed development.

3. Impacts on Regional Transportation

a. Ports and Shipping

i. Ports: Ports that were previously identified in the Regional Transportation Description (Chapter II.G.1.b) could be impacted by petroleum activities and by oil spills. During the years of petroleum activities for the proposed Sale No. 48 tracts, the crew and supply boats could operate from some of the ports to service the offshore oil and gas operation as drillships, pipelay barges, platforms, and storage and loading facilities. These service boats could operate from the following ports: Ventura and Port Hueneme could service Santa Barbara Channel, Santa Rosa Island, and Tanner-Cortes Bank; Los Angeles and Long Beach Ports-Santa Barbara Island, San Pedro Bay, and northern section of Dana Point-San Diego area; and San Diego-southern section of Dana Point-San Diego area. In addition, oil tankers and barges could operate from the Ventura area. Those tankers and barges from the Ventura area could transport crude oil to San Francisco Bay and to Long Beach. Barges could transport crude oil from Santa Barbara Island and the Dana Point-San Diego area to Long Beach. It is estimated that crude oil tankering to Long Beach could remain unchanged; crude oil to the Ventura area could increase somewhat.

During Sale No. 48 petroleum operation, the probabilities of an oil spill of greater than 1,000 barrels contacting the ports are summarized in Table III.C.3.a-1. The table indicates the following: Oil spills could contact 7 ports in the Southern California Bight area with probabilities ranging from 1 to 8 percent; Ensenada, Baja California, less than 0.5 percent; and 3 ports in the Ventura to San Francisco Tankering Leg section, between less than 0.5 and 15 percent.

Cumulative impacts of oil spills greater than 1,000 barrels contacting shores are summarized for both proposed Sale No. 48 and existing leases in Table III.C.3.a-1.

The probability that one or more oil spills of greater than 1,000 barrels from Alaskan and foreign tankers would occur and contact shore is as follows: 72 percent within 3 days, 92 percent for 10 days; 98 percent for 30 days; and 99 percent for 60 days.

The approximate ratio between the probabilities of oil spills of 50 to 1,000 barrels to greater than 1,000 barrels in the Southern California Bight area are as follows: Sale No. 48, between 1.50 to 2.94; and cumulative, between 1.51 to 2.95.

ii. Shipping: Impact on shipping from developing proposed Sale No. 48 tracts could be from the petroleum activities that were previously described above in the section under Ports. The relative impacts of these activities on shipping for the Southern California

Table III.C.3.a-1

MIXED A TRANSPORTATION, PROBABILITIES OF ONE OR MORE SPILLS AND MOST LIKELY NUMBER OF SPILLS GREATER THAN 1,000 BARRELS OCCURRING AND CONTACTING THE PORTS FOR THE PRODUCTION LIFE OF THE LEASES

Ports	Proposed Sale No. 48						Both Proposed Sale No. 48 and Existing Leases					
	3 Days		10 Days		60 Days		3 Days		10 Days		60 Days	
	P	M	P	M	P	M	P	M	P	M	P	M
Southern California Bight												
Santa Barbara	1	0	2	0	3	0	2	0	6	0	7	0
Ventura Harbor	2	0	3	0	3	0	5	0	8	0	8	0
Port Hueneme	2	0	3	0	3	0	5	0	8	0	8	0
Los Angeles	3	0	5	0	6	0	9	0	14	0	16	0
Long Beach	3	0	5	0	6	0	9	0	14	0	16	0
Newport Bay Harbor	3	0	5	0	6	0	9	0	14	0	16	0
San Diego	1	0	3	0	8	0	1	0	6	0	17	0
Baja California												
Ensenada	n	0	n	0	0	n	n	0	n	0	1	0
Tankering Leg												
San Francisco	2	0	3	0	3	0	6	0	7	0	8	0
Redwood City	3	0	4	0	5	0	9	0	11	0	13	0
Moss Landing	n	0	2	0	2	0	1	0	5	0	7	0

Source: Oil Spill Model.

P = Probability in percent M = Mode n = Less than 0.5 percent

Bight area is identified in the Proximity Analysis (Appendix F). There should be no shipping impact in the Baja California area. Shipping impacts in the Tankering Leg could be from tankers transporting crude oil from the Ventura area to San Francisco Bay and from barges hauling platform components via the Ventura-San Francisco Tankering Leg route to Sale No. 48 tracts.

For the cumulative impacts on shipping, the following proposals were considered: Sale No. 48, Existing Federal Leases, LNG tankering to Point Conception, and the Space Transportation System. J.J. McMullen Associates estimated only 9 percent nominal traffic increase in the Santa Barbara Channel through the year 2000. This estimate includes the Alaskan and foreign oil tankers. Table III.C.3.a-2 illustrates a relative comparison of shipping in the Santa Barbara Channel between the current and the proposed Sale No. 48 and Existing Federal Leases. Currently, there are 6.5 ships per day traveling in the northbound traffic lane; 5.5 in the southbound lane. Sale No. 48 could increase the northbound traffic by 2 percent; southbound, by 13.5 percent. The combined Sale No. 48 and Existing Federal Leases could increase the northbound traffic by 7.5 percent; southbound, by 53.8 percent.

Table III.C.3.a-2

SHIPPING IN SANTA BARBARA CHANNEL TRAFFIC SEPARATION SCHEME

	Northbound Lane		Southbound Lane	
	Ship/Day	% Increase	Ship/Day	% Increase
Current[a]	6.5	0	5.5	0
Sale No. 48	0.13[b]	2.0	0.74[c]	13.5
Existing Federal Leases	0.36[b]		2.22[c]	
Total Sale No. 48 and Existing Federal Leases	0.49	7.5	3.96	53.8

[a]J.J. McMullen Associates
[b]Loaded Tanker - Ventura to San Francisco Bay
[c]Loaded Barge - Ventura to Long Beach

Ships from LNG and Space Transportation could impact a specific location. LNG tankering could impact the Santa Barbara Channel traffic lanes near Point Conception. The Space Transportation System (STS) project could interfere with shipping in the Santa Barbara Channel.

The proximity analysis for shipping considers the relative value in points of impacts between vessels in the four shipping lanes and the proposed Sale No. 48 petroleum activities. The four considered shipping lanes are: Coast Guard-established Santa Barbara Channel Traffic Separation Scheme, Coast Guard-established Gulf of Santa Catalina Traffic Separation Scheme, non-established shipping routes for foreign ships, and non-established shipping lanes from San Diego to Long Beach.

The petroleum-related activities are the fixed structures, assumed location at the middle of the tracts, and the crew-supply boats servicing these structures from the nearby ports. The assumed impact point values for the fixed structures are, in order from highest to lowest point value: tracts located inside the traffic lanes; tracts, inside the separation zone; tracts, inside the buffer zone (2 miles outside the traffic lanes); and tracts outside of the 2-mile buffer zone.

The assumed impact point value for the crew-supply service boats is dependent upon the number of traffic lane crossing by each service boat when traveling to and from the structure to the port.

The Proximity Analysis on shipping could be summarized as follows: The highest impact (relative numbers of 9 and 10) on shipping could occur for some of the tracts that are located inside the Santa Barbara traffic lanes; and the lowest impact (relative number of 1) on shipping could occur in the tracts that are located in the Dana Point-San Diego tracts.

b. Offshore Pipeline System: Impact by the proposed Sale No. 48 petroleum activities in the existing offshore pipeline system will be negligible. The proposed pipeline routes are illustrated in Figure III.A.3-1 and would not cross or connect any existing pipelines. The existing offshore pipelines are described in POCS Reference Paper No. II. The majority of existing offshore pipelines are located in the Santa Barbara Channel and are within State waters.

Phillips and Union pipelines are the only offshore pipelines in Federal waters. These pipelines are located approximately 6 km (4 miles) to 10 km (6 miles) offshore from Carpinteria. The majority of the proposed Sale No. 48 pipelines are located beyond the 10 km (6 miles) from shore.

Cumulative impacts on the existing pipelines could be only from the petroleum development of Existing Federal Leases in the Santa Barbara Channel. Proposed pipelines from these leases could cross and connect existing pipelines. For example, Chevron Company is proposing an offshore pipeline from a proposed platform, in Federal waters, to an existing platform, in State waters. These pipelines would cross existing Phillips and Union pipelines and connect with existing pipelines at the existing platform.

4. Impact on Military Uses: As discussed in Section II.G.1.c and shown on Visual No. 3 of this ES, the entire Southern California Bight is used by the Department of Defense for one type of activity or another. Continued detailed discussions combined with a close working relationship has resulted in an agreement for co-utilization of the areas with a few exceptions as discussed below. It is also recognized that in some areas a closer examination of potential problem areas will have to be done and may result either in some additional lease stipulations or in voluntary cooperation by the oil companies.

a. Camp Pendleton Amphibious Vehicle Training Area (CPAVA): This area of ocean and associated shoreline between San Mateo Point and Oceanside represents a unique area for the military, and beach assaults are conducted as part of the war games that are scheduled. Approximately one-eighth of Tracts 147 and 149 extend into the CPAVA area. The military has indicated that this will not pose an unacceptable inconvenience to them; however, close liaison will have to be maintained and later, if development is contemplated, they may have additional recommendations.

b. Camp Pendleton Amphibious Assault Area (CPAAA): Tracts 143, 145, 146, 147, 148, 149, 150, 151 and 152 fall within this operating area. Operating area CPAVA also lays within this area so the same concerns discussed above exist. During exercises, large amphibious assault craft such as LPH's and LHA's manuever in this area, and particular care will have to be exercised in placement of any development platforms to ensure that they would not interfere with the expected maneuvering patterns of these vessels. Special provisions may also have to be made for piping oil ashore if it becomes necessary to run pipelines over beaches that are used for landing and assault exercises.

c. Encinitas Naval Electronic Test Area (ENETA): As a direct result of OCS Sale No. 35, the Naval Oceans Systems Center (NOSC) was forced to relocate their Long Beach Torpedo Test Range. After a careful survey of the Southern California Bight, NOSC selected the area now designated as ENETA, which is the last remaining area that will fulfill their requirements considering location, bottom conditions, water depths and ability to control civilian surface traffic. In addition to research and development activities related to torpedo development, there is torpedo launching against underwater artificial targets and submarines as part of fleet training exercises. NOSC feels that at least a 10-mile buffer zone is required for safety purposes. Tract 153 and approximately one-third of Tracts 151 and 152 lay within the ENETA area. The Navy has agreed to joint usage in the case of Tract 151. Further, the Navy has agreed to the leasing of Tracts 152 and 153, if drilling activities are restricted to the western one-third of the tracts.

d. Submarine Transit Lane, Sierra Zeus: Tracts 158, 159, 160, 161, 162, 163, 164, 165 and 166 lie within and completely block this submarine transit which is the approach to San Diego Harbor. For safety purposes, the fleet will normally not permit two submerged objects within 5 miles of each other at sea. This means that if drilling activities are taking place, submarines would have to transit on the surface. On the average, there is one submarine going in or out of San Diego Harbor each day. Nuclear submarines, in particular, have a very short sail and are not designed for surface transit. In addition to a great deal of rocking and rolling on the surface, visibility is poor and sailors stand the chance of being washed overboard. Normally, submarines surface as they approach the continental shelf (600 feet of water depth). If the tracts presently proposed are leased, it would require the submarines to surface or submerge approximately 10 miles earlier/later than they normally would. This would also require that the submarines move much slower than they normally would, thereby increasing their travel time.

e. Submarine Transit Lane, Sierra Mars: Tracts 167, 168, 169, 170, 171, 172, 173, 174, 175 and 176 lie within this transit lane. The same concern is shared here as was for transit lane, Sierra Zeus.

f. Submarine Transit Lane, Sierra Apollo: Tracts 215, 216 and 217 lie within this transit lane. The same concern is shared here as was for transit lane, Sierra Zeus.

g. Fleet Training Area (FLETA) - Non-Firing Area (FLETA COLD): Tracts 205, 209, 212, 213, 214, 215, 216 and 217 lie within this area. The entire area is frequently used (between this and CBCOA, the area is in use over 50 percent of the hours in any one year) by aircraft carriers and other large ships making high speed runs. Particularly, in the case of the aircraft carriers when landing or launching aircraft, the ability to maneuver is very limited. Another major point of concern are the aircraft activities associated with the surface maneuvers. Major commercial air corridors lie immediately to the north. The FAA provides radar separation to commercial carriers to eliminate any possible accidents. If fleet activities are forced to move outside their scheduled areas, it requires closing or relocating the commercial air corridors, creating other problems which the military tries to minimize.

h. San Diego Harbor Entrance: (Tracts 157, 158, 159, 160, 161, 162, 163, 164, 165 and 166) Because of the large amount of military ships going in and out of San Diego Harbor daily, the military would like to work closely with the Department of the Interior in developing stipulations which would minimize any impact on military activities.

They can work around exploration activities as long as close liaison is maintained so that the military knows when and where any drilling activity will be taking place. If sufficient oil and/or gas is located to cause development, there are several mitigating measures which could minimize the impact on military activities. These measures would vary greatly, depending on the extent and location of the development activity. For this reason, it is desirable to wait until possible development activity can be defined to detail any mitigating measures.

i. San Clemente Island: Due to the unique nature of the San Clemente Island facility, there are numerous military activities of all types scheduled continuously in the area. For this reason, the Navy has requested a 25-mile buffer zone. Approximately 50 percent of Tract 185, 80 percent of Tract 189, and 20 percent of Tract 194 now fall within this buffer zone. This will not cause a foreseeable problem, but the Navy has expressed concern that activity could take place so close to the buffer zone.

j. Combat Systems Evaluation Range (CSER)/Shipboard Electronics Systems Evaluation Facility (SESEF): This is a facility operated by the Long Beach Naval Shipyard and involves the testing and analysis of ships' antenna radiation patterns, passive electronic counter-measures and direction-finding equipment calibration and various electronic systems testing. There is no other place that the buoy, which is the center of this system, can be located. The buoy is located in the approximate center of Tract No. 124. Military activities can be scheduled around exploratory drilling. Development could be tolerated if no surface hardware is located within a 3-mile radius of the buoy. If a platform is located within this 3-mile radius, it would require closure of this facility. The Navy has agreed to joint usage of this area.

k. Cortez Bank Carrier Operations Area (CBCOA): There are 21 proposed tracts in this area (180, 181, 182, 186, 190, 191, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210 and 211). Military concerns for this area are the same as discussed under FLETA COLD, above.

There was a special recommendation by the Department of Defense that 15 tracts (119, 203, 204, 205, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216 and 217) not be considered for leasing in Sale No. 48. While detailed reasons were not provided, it is assumed that it is because of the specialized and high usage, some of which is discussed above. If this is the case, it is not clear why Tract No. 208 and the associated Tract Nos. 203, 204, 205, 207 and 210 were mentioned. Tract No. 208 has Bishop Rock within it, along with many shallow-water areas that would preclude fleet activities. The associated tracts fall within the north-west corner of the FLETA COLD operating area, and any fleet activities would have to turn with a wide radius to stay clear of the shallow-water area.

5. Impacts On Ocean Dumping: As discussed in Section II.G.1.d, ocean dumping is now prohibited except on a case by case basis with the exception of the five dredge material disposal sites listed in Table II.G.1.d-1. Assuming maximum development on all tracts presently being studied for Sale No. 48, the only impacts on past or present dump sites are as follows:

Tract No. 131. The Newport Beach (LA 3) dredge material disposal site (Table II.G.1.d-1) is located within this tract. Dumping while drilling or development activities are taking place could pose a possible hazard or at the least a nuisance value and may require relocation of this disposal site.

Tract No. 166. The San Diego (LA 5) dredge material disposal site (Table II.G.1.d-1) is located within this tract. Dumping while drilling or development activities are taking place could pose a possible hazard or at least a nuisance value and may require relocation of this disposal site.

Tract No. 165. This tract lies within an area that was previously designated as a chemical dumping area. No records have been found that indicate type or quantities of chemicals that were dumped in this area, however, there has been no dumping for many years now and it could be safely assumed that materials previously dumped would have long ago dissipated and pose no threat to drilling activities. It can, therefore, be assumed that there is no impact by chemicals previously dumped and since there will be no further dumping activity at this site, leasing the tract will not impact dumping activity.

Tract No. 157 - Average water depth 925 meters (3034 feet)
Tract No. 158 - Average water depth 650 meters (2132 feet)
Tract No. 160 - Average water depth 775 meters (2542 feet)
Tract No. 162 - Average water depth 1110 meters (3640 feet)

These tracts lay partially within an area that was designated as an explosive dumping site (Table II.G.1.d-1, site No. 17). The area is no longer used for dumping. During the years it was used, poor records were kept on type and quantities of ordnance and explosives dumped and, particularly, exact locations where it was dumped; so it is very doubtful if searching past records would provide any useful information. Additionally, the depth and steep slope in this area make surveying difficult to determine what is on the bottom in any locality. It is unknown if any hazards would be represented, however, it is assumed that being aware of the past history of the area, any company working in the area will take appropriate measures to eliminate any possible risk.

6. Impact on Offshore Cultural Resources: Submerged cultural resources, consisting of sites or objects of prehistoric or historic value, may be impacted by both normal operations and by accidents. They may be adversely affected directly through disturbance, destruction or contamination, and indirectly by making it difficult or impossible for investigators, working subsequent to lease activities, to detect sites or objects.

Direct impacts may come from work activities during exploration, development, production and abandonment stages of lease life. In addition, oil spills may cause adverse impacts, although they probably represent a relatively low risk to submerged cultural objects or sites. Spill impact would most likely be in the form of contamination which would alter the appearance of the object or interfere with radiocarbon dating. However, since most of the oil sinking in a spill is the more viscous fractions it would tend to be less mobile once on the bottom. Also, most objects or sites on the seafloor are likely to be coated with a veneer of sediment, unless in a higher energy environment. In either event, tarry oil would tend to be kept away from the surface of objects or else it would tend to remain mobilized until it had left the area and reached a lower energy environment. Oil spills, thus appear to represent a low threat to submerged cultural resources.

Activities during exploration which can cause adverse impacts are drilling for sediment or stratigraphic samples, dragging dredges or trawls on the bottom to obtain rock or sediment samples, box coring, anchoring to perform sampling activities and the use of high explosives as energy sources in deep seismic work. Most of the activities involve either a relatively limited cross-sectional area of seafloor or relatively shallow bottom disturbance, thus the odds of affecting an aboriginal site are fairly limited. A shipwreck with portions protruding above the sediment line may be affected if a dredge or corer happened to be dragged through or placed on the wreck. The odds against that occurring are relatively high, however, owing to the relative density of significant wrecks, particularly those with portions protruding above the sediment. The use of high explosives in close proximity to the bottom could result in sediment mobilization and consequent damage to any cultural resources which may be involved. High explosives are seldom used in seismic survey work in these waters and those which are used are generally deployed in water which is too deep for cultural resources to be likely or are deployed far enough above the bottom to preclude sediment mobilization due to the blast overpressure. Therefore, explosives are considered a low source of risk.

In exploration and development drilling, risks to cultural resources escalate. Drill ships or rigs are positioned over the wellsites where they remain over several weeks to months of drilling and

possibly, testing. Drill ships typically are anchored by 8 to 10 anchors weighing 9,072 to 13,608 kg (20,000 to 30,000 lbs). These are placed at distances ranging from 7 to 12 times the water depth away from the vessel and attached to it by combinations of chain and cable. Anchors are emplaced by placing them on the deck of work boats, hauling them out to the desired location and dropping them overboard. Winches then tension the lines, dragging the anchors until the flukes catch and the anchor buries itself in sediment or catches on rock outcrops. Enormous tensions are applied once all the anchors are emplaced and the vessel is held rigidly over the "hole." Changing sea or weather conditions may result in heading changes to lessen the effect on the vessel. As heading or tensioning changes are made, portions of the anchor chains drag across the bottom or rise and fall contacting the bottom or clearing it. Anchors are recovered by either lifting them up to the work boat by a tag line which is attached to a buoy over the anchor or by dragging the anchor back to the drill ship or rig. The former method is said to be favored, although side scan sonar records of abandoned drill sites frequently show evidence of anchor dragging.

The well bore itself begins as a hole 0.9m (36 in.) in diameter at the surface, and tapers to much narrower diameters as it progresses deeper. Steel well casing is installed to a depth which is determined by stratigraphic, hydrologic and pressure conditions encountered in the various zones penetrated. This casing may be blown off by explosives a few meters below the mudline after the well has been plugged for abandonment or if reentry is contemplated, the wellhead may be left in place. The explosion may create a "dimple" or depression on the seafloor. The remainder of the casing stays in the hole and may amount to several hundred meters in length. When operating, the vessel is the source of noise, both in acoustic ranges and in magnetic fields. During drilling, work boats ferry supplies and solid waste to and from the drilling vessel. Tools and supplies are occasionally lost overboard. Reputedly, solid wastes such as steel cable, drill pipe, etc., are intentionally, though unsanctioned, jettisoned from transiting work boats.

Adverse impact which may arise from anchors and anchoring activities is the very obvious potential for physical damage due to an object being contacted by the anchor or chain. Digging into sediments, an anchor and a length of chain can contact deeply buried objects or sites. The weight and size of the anchor combined with the great forces applied to keep the vessel positioned guarantee that any cultural object or highly compacted site are going to be greatly altered and damaged. Objects caught in the bight of the anchor lines when heading changes are made, may be reduced to rubble as the lines are re-tensioned and snap across the bottom or saw back and forth. Recovery of anchors by dragging produces great scars in

soft bottoms as the anchor oscillates or turns over. Such recoveries resulting in contact with a vessel on the bottom or shallowly buried or shallow aboriginal sites would create large damage.

Well casing remaining in the hole following abandonment, acts as a large monopole magnet under the influence (induced magnetization) of the earth's magnetic field. The individual lengths of casing also exhibit permanent magnetization formed as a result of manufacturing and welding processes. The result of this is a large magnetic anomaly which dominates the magnetic field for a great distance around the casing. The influence of a casing on the local magnetic field is felt much further away than would the influence of a comparable mass of metal arrayed in a lump rather than linearly. This is due to the relationship of magnetic force lines around the end of a monopole as compared to that around a dipole. The intensity, T, from a monopole increases according to the equation $T=M/r^2$ while the equation for a dipole is $T=2M/r^3$ off the end of the dipole and $T=M/r^3$ off the side of the dipole. M= magnetic moment and r the distance to the pole. It can be seen that the monopole's influence extends for a much greater distance than that of the dipole. A further discussion of magnetics is in a following section. The effect a casing has on cultural resources is to preclude or render difficult a magnetic search for vessels.

The disturbance of the bottom created by the actual well bore is not a major problem as the odds of striking a shipwreck are minimal and if it penetrated an aboriginal site, the area of the site disrupted would be small. Numerous wells such as at a platform site, naturally increase the risk level. When casings are blown off at abandonment, a considerable area is subject to possible disturbance and this constitutes a source of adverse impact.

Although prohibited, metallic and other debris is occasionally thrown overboard from workboats and drilling vessels. Accidental losses of equipment occur while transiting to and from drillsites and supply areas, or while transferring equipment between drilling and supply vessels. The result is an accumulation of debris near drillsites and on the seafloor between the site and shore. This debris, if ferromagnetic, creates magnetic anomalies which interfere with subsequent magnetic searches for shipwrecks or other objects of cultural resource interest. Divers investigating seafloor conditions at the drillsite, or the source of anomalies discovered during cultural resource surveys, may either pilfer objects from cultural resource sites so discovered or disclose the location to others who may recover such objects.

The operating of various motors, winches, pumps and other equipment on the drilling vessel creates a whole spectrum of sound and electromagnetic frequencies and magnetic fields. These frequencies

and fields can be picked up by remote sensing equipment conducting surveys for hazards and/or cultural resources elsewhere in the tract or adjoining tract and create noise in the records obtained. This noise can make interpretation of the records much more difficult and may mask valid data, depending upon its severity.

Impacts arising during production phases come from drilling numerous wells either directly below the platforms or at varying distances from it and connected to it by pipelines. Platforms themselves cover a considerable area of seafloor and are fastened in place by driving numerous pilings or clusters of piles. This results in considerable bottom disturbance. Platforms also create large magnetic gradients which extend for great distances away from them. Sonar reflections from platforms create very dense records which mask data from other nearby sources. Acoustic frequencies are also created by platforms and may cause noise in sonar records. Debris accumulates around platforms and areas occupied by waiting work boats in much the same manner as it does in conjunction with exploratory and development drilling discussed earlier. Pipelines and cables between wells and platforms, adjacent platforms, and platforms and shore are sources of adverse impacts. Pipelines and steel or electrified cables create magnetic fields influencing large areas. The installation of pipelines requires burial in shallow waters and the anchoring of lay barges as they place the pipe. The anchors, though not as large as those on drilling rigs, still create a zone of disturbance subparallel to the pipeline alignment. Clamshell dredging or jetting to bury the line also constitutes a great hazard to any cultural resources along the route alignment. If tankers or barges are anchored near a platform rather than tied up to it, then their anchoring could hazard any shallowly buried or surficial cultural resource present.

During abandonment, removal of the platform and seafloor obstructions due to wells and wellheads, may result in considerable bottom disturbance due to the use of explosives and dragging to retrieve debris. When completed, abandonment still leaves casing in the hole, pilings below the surface and any unrecovered metallic or other debris. This leaves a large magnetic anomaly source or sources with a long lifetime.

Accidents occasionally occur resulting in the loss of rigs, supply boats and helicopters. As these find a resting place on the seafloor, they become the source of another anomaly which makes the discovery of significant cultural resources more difficult.

a. Submerged Cultural Resources: Cultural resources on or in the seafloor may have come to rest there by any of several means. Hudson (1976) identified ten different theories accounting for the presence of offshore aboriginal materials. It appears that

a combination of these theories is necessary to explain all of the finds. Briefly, these theories are as follows:

(1) Coastal Outwash - Artifacts which were deposited on land were picked up by terrestrial erosion processes and transported by streams to the sea.

(2) Modern Earth Moving - Excavation on land which picked up artifacts and transported them offshore for use in artificial reefs, breakwaters and dredge spoil disposal.

(3) Wave Erosion - Cliffs collapse into the sea as they are undercut by waves and the artifacts on them are carried offshore.

(4) Ceremonial Deposition - Vessels used in religious or initiation ceremonies were deposited intentionally in the sea.

(5) Random Loss - Objects were accidentally lost overboard.

(6) Cairns - Cairns may have been built in the sea, extending a practice known to have existed on the mainland.

(7) Ballast - This holds that ships' crews picked up rocks, which included artifacts, for ballast which was later jettisoned at sea. A related theory holds that Indian canoes were responsible for the same.

(8) Anchors - Large stones, including artifacts of manufactured tools or vessels, were used as anchors and lost.

(9) Coastal Subsidence - Subsiding coastal lands resulted in submergence of formerly dry lands.

(10) Eustacy - Changing sea levels have resulted in inundation of formerly dry lands.

While several of these theories are rejected for the Santa Barbara Channel, several remain viable.

On the OCS, the most viable theories are random loss and eustacy. Random loss would result in widely scattered artifacts which might be correlated to travel routes and possibly to rough water areas thereon. Eustatic changes appear to offer the most viable means by which currently detectable cultural materials came to be on the

seafloor or buried in it. During the period of continental glaciation, lowered sea level would permit early man to occupy large areas of land in the Southern California Bight which are now submerged. Habitation sites as well as resource exploitative and other types would exist on these land and former coastal areas. The existence of known or suspected occupation sites on the seafloor is corroborated by both Hudson (1976) and Moriarty (1975). The prospect of locating single artifacts or small concentrations of artifacts over the vast acreages of the outer continental shelf with currently available technology at an acceptable cost is remote. In limited areas and moderate depths, visual observations either singly or in conjunction with remote sensing surveys, can be used within reasonable cost bounds and with reasonable prospects of detecting single or small groupings of artifacts, should they be present. These circumstances generally prevail in the shallower nearshore water. On the OCS, detection of aboriginal sites with surveys covering large areas will have to depend on environmental correlations and paleoenvironmental reconstructions. Currently, occupation sites appear to present the highest discovery potential. Studies have been undertaken to determine what these correlations are and to better define areas of higher probability on the OCS. These have been completed for several OCS regions. For the Southern California Bight, a study is completed, but the feasibility of constructing paleoenvironmental correlations has not yet been tested. A few of the many features which may be correlative with occupation sites, as well as detectable with current technology, are beach ridges, bay barriers, barrier islands, stream channels, alluvial areas adjacent to stream channels, terrace and deltaic features. Identification of these features on or below the seafloor, when correlated with occupation sites and in conjunction with other data, indicates a high potential that aboriginal sites are present. Actual sites may be identifiable by such features as the increased density of the soil from foot traffic and pits or depressions from shelters or other activities. Middens or collections of stone artifacts may produce sufficient density contrasts to be detectable. The detection of aboriginal sites utilizing technology applicable to extensive surveys will remain dependent upon the identification of associated geomorphic features until future research has refined the experimental design and necessary technologies are produced.

Shipwrecks are very important to archeologists because they capture an instant in the life of a culture and preserve it generally undisturbed. On board a ship are nearly all the necessities and many of the amenities of life during the period. Tools for normal life pursuits like carpentry, sailmaking, shoe repair, cooking and eating were present, as well as cargo and personal items of passengers and crew. Due to long lengths of time away from ports and civilization, much had to be carried along to maintain the vessel and personnel. When the vessel sunk, it was generally in the violent

circumstances of war, storm or sudden encounter with unseen reefs, none of which usually provided ample warning or opportunity to salvage. Materials recently salvaged from old wrecks include such small and perishable items as fabrics, spools of ribbon, hats, shoes, foodstuffs, awls, sailmakers needles and even a cockroach. The remains of ships, particularly the older, more significant ones are usually far more prosaic than the wrecks pictured in movie and book. The popularized version has the vessel sitting on the bottom largely intact with a few degrees of list, masts aloft and a few shreds of rigging waving lazily from the yard arms. More commonly, the wreck is barely discernible to casual observation, with little protruding above the mudline and that which is, being thoroughly covered by encrusting marine organisms and deposits.

Often it consists of scattered clusters of buried objects, strewn across the seafloor as the vessel broke up or drifted while sinking. Exacting surveys are necessary to detect these types of remains.

A substantial record of shipwrecks and missing vessels exists for Southern California. The accuracy of location data from these records is extremely variable. Most reports are from secondary sources and some perpetuate errors or myths. Until recently, the means of precisely locating oneself at sea were unavailable so stricken ships were unable to give accurate locational data. Losses also were frequently reported as occurring at the same city first reached by the survivors. Many small coastal vessel losses were not even reported except in local newspaper accounts.

As a result, some vessels or unidentified wrecks are precisely located, while varying degrees of generality exists for many others. The older usually more significant vessels are usually the ones with vague locations. In summary then, surveys on the OCS over extensive areas will be for geomorphic features and for wreck remains ranging from widely scattered or buried materials to intact vessels.

Cultural Resources Surveys. Federal agencies are required by Executive Order and by statute to not inadvertently destroy cultural resource values of significance located in areas under their jurisdiction. To fulfill that obligation, the Bureau of Land Management, the National Park Service, Office of Interagency Archeological Services, (now Heritage Conservation and Recreation Service, [HCRS]) and the Geological Survey developed survey procedures which are implemented prior to drilling or construction activities on leases. These surveys utilize remote sensing equipment to gather data which are then interpreted for anomalies which may indicate the presence of cultural resources. The instruments used are the magnetometer, dual side scan sonar, subbottom profiler and water depth recorder. These are deployed in a manner stipulated in Notice to Lessees and Operators of Federal Oil and Gas Leases in the Outer

Continental Shelf, Pacific Area (NTL 77-3, March 1, 1977) reproduced in Appendix C.

Magnetometers are instruments which measure the ambient magnetic field of the earth and any local or regional perturbations in it. These perturbations or "anomalies" are caused by magnetized or magnetically susceptible materials either man-made or naturally occurring. Naturally occurring or geologic anomalies are caused by concentrations of magnetite or rocks containing high percentages of ferromagnesian minerals. Igneous rocks tend to be fairly magnetic and where they occur unevenly such as in dikes, faults and outcrops create local or regional magnetic anomalies. Man-made magnetic sources include iron and steel objects (except stainless steel), fired pottery or clay objects and rocks which have been heated. Objects such as tools, vessels or ballast stones constructed of naturally magnetic rocks, would cause an anomaly.

The two types of magnetism are induced and permanent (remanent when applied to rocks). Induced magnetism results from the interaction of the magnetic property of the material or "permeability" and the orientation and shape of the object with the earth's magnetic field. Permanent magnetism is a property inherent in the material and is related to the object's thermal and mechanical history. Permanent magnetic effects usually overshadow induced effects although the observed anomaly is the sum of the induced and permanent fields.

Long objects such as pipelines or well casings tend to have large anomalies, depending on their orientation to the earth's field. Individual pipe sections often exhibit anomalies differing from adjacent sections. Because of their great length and orientation, well casings and heads produce some of the largest man-made anomalies.

In searching for anomalies, it must be remembered that anomaly strength falls off rapidly with distance according to the formula $T=M/r^3$ where T is the anomaly in gauss (1 gauss = 10^5 gammas), M is the dipole moment in cgs units and r is the distance in centimeters. For a doubling of the sensor-to-object distance, the anomaly strength decreases by a factor of 8. Distance from the anomaly source can thus be seen as a critical factor. In fact, "One must pass within the near vicinity of such objects ...as individual items, such as anchors, iron debris, ships and other finite-sized objects," (Breiner, 1975). Breiner again cautions concerning the difficulties of finding objects in marine searches, "In fact, it is prudent to be extremely conservative in any estimates for the amount of time the search may require, the distance at which one may detect a given object and the probability that a given object would even be detected or mapped. Even among these kinds of problems are those related to the location and navigation of the surface vessel, the approximate location of the object to be detected or mapped and the difficulties in towing

a sensor near the bottom in a dynamic and hostile environment typical in marine or inland water areas."

Figure III.C.6-1 is a nomogram showing the relationship between differing weights of iron and the anomalies produced at varying distances. From this table the rate of falloff is evident. A rough rule of thumb is that 900 kg (1 ton) of iron relates to 1 gamma at 30 m (100 feet).

The sensitivity of a magnetometer is at least 1 gamma and may be 0.1 gamma under some circumstances. The repetition rate or the time between successive readings by the unit is adjustable from 3 times per second to 6 seconds. At higher tow speeds, the magnetometer may miss anomalies if the slower repetition rates are used. Data readout is on a digital display on the console and can be digitally recorded on tape. Normal records are in the form of paper strip charts. Scales used range in various increments from 10 to 1000 gammas.

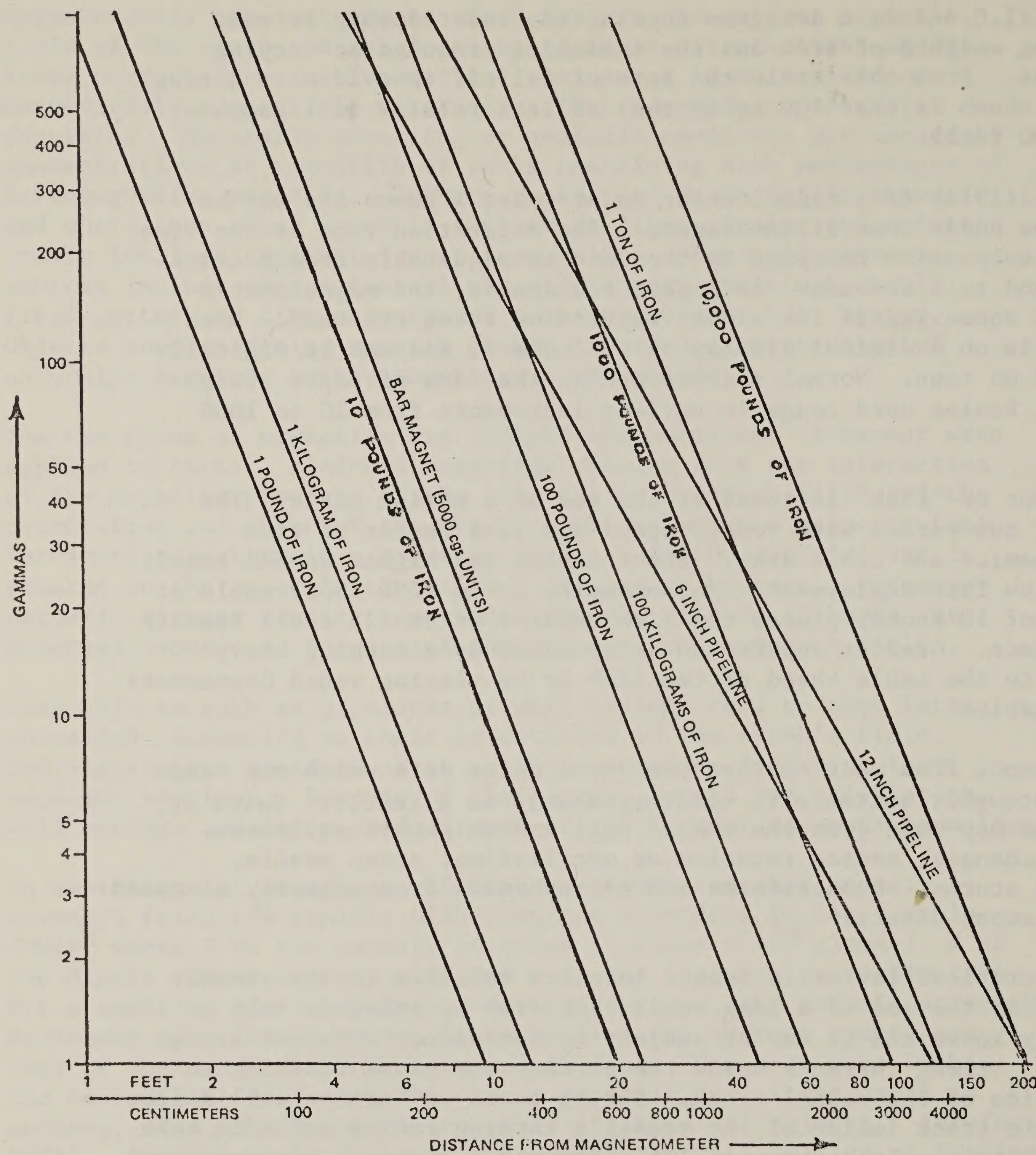
The sensor or "fish" is towed at the end of a marine cable. The depth of tow varies with vessel speed and is a factor of fish hydrodynamics and cable drag. Short cables and higher speeds result in shallow fish deployment. For example, a 76m (250 foot) cable at a speed of 10 knots, places the fish about 7 or 8m (25 feet) beneath the surface. Greater depths can be obtained by attaching heavy weights to the cable ahead of the fish or by placing vaned depressors on the cable.

Interference from many sources can cause noisy data which may range from thoroughly suitable to uninterpretable as a result. Noise or anomalies may come from the vessel hull and shipboard equipment, heading changes, sensor rotation or oscillation, ocean swells, magnetic storms, thunderstorms and microphonics from severely stressed cables, among others.

Another critical factor is sensor location relative to the vessel. Deployed at the end of a long cable, the fish location is only generally known and it may be subject to forces not apparent at the surface. Strong currents below the surface may cause tracking to either side of the vessel track. During turns the sensor will follow an arcuate track inside of the vessel's turning radius and will take a long distance after the vessel has assumed a straight heading before it assumes a parallel heading. Vessel heave may be transmitted down the cable causing the sensor to swing from side to side. This causes aberrant anomalies.

The effective resolution of the magnetometer is affected by geological background gradients, diurnal magnetic variation and other sources. This makes the identification of anomalies of a few gammas, occurring

Figure III.C.6-1 Nomogram for Estimating Anomalies from Typical Objects (assuming dipole moment $M = 5 \times 10^5$ cgs/ton, i.e., $k = 8$ cgs. Estimates valid only within order of magnitude)



INSTRUCTIONS FOR USE:

To use the nomogram, select a given weight or type of object from among the diagonal labeled lines. Then choose a distance along the bottom line (abscissa) of the graph and follow a vertical line upwards from that distance until it intersects the diagonal line of the selected object. At that point, move horizontally to the left to a value on the vertical axis (ordinate) of the graph and read the intensity in gammas.

At a given distance, the intensity is proportional to the weight of the object. Therefore, for an object whose weight is not precisely that of the labeled lines, simply multiply the intensity in gammas by the ratio of the desired weight to the labeled weight on the graph. If the distance desired does not appear on the graph, remember that for a typical object the intensity is inversely proportional to the cube of the distance and for a long pipeline the intensity is inversely proportional to the square of the distance between magnetometer sensor and object. Due to the many uncertainties described herein, the estimates derived from this nomogram may be larger or smaller by a factor of 2 to 5 or perhaps more.

(reproduced in modified form, by permission from Applications Manual for Portable Magnetometers) Source: Breiner, (1975).

over a distance of several tens of meters, very difficult or impossible even if the noise level only reaches 1 gamma (Breiner, 1975).

The strengths of some common anomaly sources are shown in Table III.C.6-1. In addition to possibly magnetic ballast stones, sailing vessels carried several hundred pounds of iron in fittings, nails, tools, etc. These objects are in varying states of concentration and orientation so the anomaly strength is quite variable.

Search design should be based upon the maximum probable anomaly. Knowing this, search feasibility and techniques are determined. Sensor height above the bottom and grid spacing are then selected. The grid should be such that any anomaly appears on any two adjacent tracks, "particularly if the water depth is great and control of the sensor position minimal" (Breiner, 1975).

It is evident that many factors exist that affect the efficiency of magnetic search. The manner in which the equipment is deployed and operated will determine whether the final results are usable.

Dual side scan sonars are acoustic devices which produce semi-pictorial readouts on moving paper charts of ocean floor features and objects on it and any objects or items in the water column having sufficient acoustic reflectivity contrast (impedance mismatch) to produce an anomalous record. Sources range from rocks or other solid objects on the seafloor to gas bubbles in the water. The device can detect small objects like aircraft parts, small vessels, well heads and oil drums. A car body can, reportedly, be detected with certainty inside a 150m (500 foot) range.

Tow height of the sensor or fish above the bottom is important to attain good records and must be adjusted to account for bottom relief and character, water depth and range coverage. The vertical angle of the acoustic beam is adjustable in both width and downward tilt and should be adjusted to fit water depth.

Speed of tow greatly affects record quality and interpretability. Transducers in the fish emit acoustic beams with an angle ranging from 3/4 to 2 degrees wide and at a pulse rate varying by range setting from 15 pulses per second to 1.5 pps. At high tow rates, blank areas will appear because the boat covers more distance along the track than the beam width can cover at the selected pulse rate. The more energy returned from an object, the greater are its chances of discovery, thus at lower tow speeds several pulses may be returned to the fish and recorded rather than one or none. High tow speeds also cause compression of the apparent image of an object along its axis parallel to the survey track. Distortion of this sort is illustrated in Figure III.C.6-2 and can make record interpretation

Table III.C.6-1

Table of Anomalies of Common Objects

Typical Maximum Anomaly

Object	Near Distance	Far Distance
Automobile (1 ton)	30 feet 40 gammas	100 feet 1 gamma
Ship (1000 tons)	100 feet 300 to 700 gammas	1000 feet 0.3 to 0.7 gammas
Light Aircraft	20 feet 10 to 30 gammas	50 feet 0.5 to 2 gammas
File (10 inch)	5 feet 50 to 100 gammas	10 feet 5 to 10 gammas
Screwdriver (5 inch)	5 feet 5 to 10 gammas	10 feet 0.5 to 1 gamma
Revolver (38 special or 45 automatic) (induced approximately equal to permanent, see text)	5 feet 10 to 20 gammas	10 feet 1 to 2 gammas
Rifle	5 feet 10 to 50 gammas	10 feet 2 to 10 gammas
Ball Bearing (2mm)	3 inches 4 gammas	6 inches (0.5 feet) 0.5 gamma
Fenceline	10 feet 15 gammas	25 feet 1 to 2 gammas
Pipeline (12 inch diameter)	25 feet 50 to 200 gammas	50 feet 12 to 50 gammas
DC Train	500 feet 5 to 200 gammas	1000 feet 1 to 50 gammas
'Cow' magnet (½" W. 3" L)	10 feet 20 gammas	20 feet 2 gammas
Well casing and wellhead	50 feet 200 to 500 gammas	500 feet 2 to 5 gammas

(Note: anomalies are only representative and may vary by a factor of 5 or even 10 depending upon the many factors described herein).

Source: Breiner, (1973).

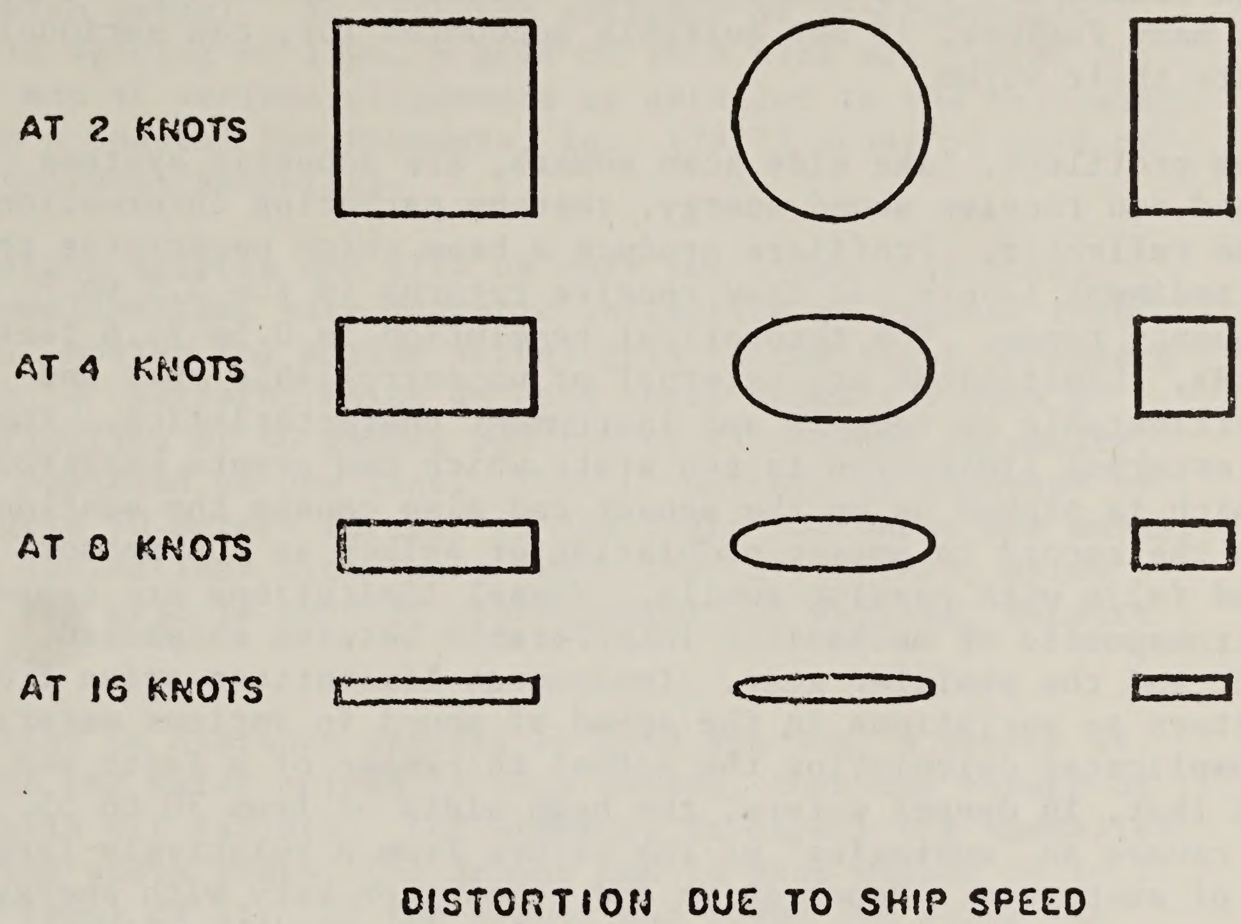


Figure III.C.6-2 Illustration of How Common Shapes Appear Compressed on a Side Scan Record Due to Ship Speed.

Source: EG&G (N.d.).

difficult. Use of slow paper speeds can cause compression of the records, making interpretation difficult or impossible.

Some other factors causing debilitated record quality are cross-talk caused by leaky cables, interference from other instrument systems being simultaneously operated, gas bubbles in the water column and steeply sloping bottoms.

Side scan sonars are very versatile and effective tools for survey work but many factors, if not suitably accounted for, can seriously depreciate their value.

Subbottom profilers, like side scan sonars, are acoustic systems which send and receive sound energy, thereby gathering information about the reflector. Profilers produce a beam which penetrates the shallow sediment layers and they receive returns in the 3.5 to 7 kHz frequency range. The theoretical resolution is 0.5m (1.6 feet) at 3.5 kHz. Limitations are external or uncontrollable ones and those attributable to vessels and instrument characteristics. The primary external limitation is sea state which can create background noise which is picked up by the sensor and also causes the seafloor trace on the record to appear undulating or spikey as the sensor rises and falls with passing swells. Vessel limitations are caused by electromagnetic or mechanical interference between shipboard equipment and the profiler gear. Instrument limitations arise from such factors as variations in the speed of sound in various materials, which complicates calculating the actual thickness of a layer and the fact that, in deeper waters, the beam width of from 30 to 55 degrees causes an "averaging" of the return from a relatively large section of subbottom. Penetration and resolution vary with energy sources, gain settings, and frequencies as well as with sediment characteristics. Record compression due to slow chart speeds creates interpretation problems. Without proper manipulation of adjustable variables, shallow sediment layers, those which are generally of greatest interest archeologically, can be uninterpretable due to washout or overdarkening.

Water depth recorders are acoustic instruments providing a continuous chart profile of the seafloor.

From the preceding discussion, it is evident that properly deployed and operated remote sensing equipment is capable of satisfactorily detecting marine cultural resource values.

Protection of cultural resource values depends upon accurate relocation ability. Navigation systems now available, operate in the radar bands of the microwave spectrum and produce relocation capability of a few meters and even to the nearest 0.1 meter (0.33 feet) for some systems.

Survey grids should be designed so that an adequate reconnaissance of the area in question is obtained. Searches for suspected Spanish vessels, as reported in the literature and in personal communication, utilize track spacing ranging from 10m (33 feet) to 50m (164 feet). Computational approaches corroborate this as being virtually certain of detecting the target. The magnetometer is the most limiting instrument used on surveys and the most valuable for shipwreck detection. Figure III.C.6-3 shows a magnetic contour map of a 16th Century Spanish vessel. To test the efficacy of the currently required grid spacing of 150m, a grid of this size was placed on the contour map at various alignments as detailed in the following excerpt from a Coastal Environments, Inc. (1977) study of Gulf of Mexico OCS Cultural Resources.

"The 'A' pattern detects the site on only two lines with three separate anomalies that have magnetic inflection no greater than five gammas. Moving the entire survey grid to the right 50 meters produces the 'B' pattern, which detects three anomalies with a magnetic inflection of 40 gammas and two of five-gamma intensity, and is only observed on one line. The 'C' pattern is achieved by moving the grid 50 meters farther to the right and shows one anomaly at 30-gamma inflections with two peaks. The 'D' pattern, which occurs when the grid is shifted approximately 45 degrees, detects no anomalies."

If, in addition to distance created by grid spacing, a sensor is towed high in the water column in deep waters, then the chance of detection falls off rapidly. For example, to detect the anomalies created by the above wreck, the sensor had to pass within 20 to 30 m (66 to 98 feet) of it. If the sensor was towed 30m below the surface in 100 meters (328 feet) of water, the wreck would not have been detected. For even a marginal probability of detection, the survey track would have to have been directly over the anomaly source and the sensor would have had to be 70 to 80m (230 to 262 feet) below the surface and this assumes that all other factors were ideal.

Survey standards required to be followed by the Pacific Area Geological Survey, Oil and Gas Supervisor are detailed in NTL 77-3 dated March 1, 1977. Cultural resource impacts potentially caused by this proposal will be analyzed according to this NTL and the way it and its predecessors have been implemented.

The initial lease-associated protection step for cultural resources is contained in the "Cultural Resources" Stipulation which is made a part of all leases. Compliance with its provisions is detailed in the NTL and by subsequent interpretations and actions by the Supervisor. The OCS Manager and Office of Interagency Archeological Services Act in an advisory capacity.

Figure III.C.6-3 Computer-drawn, two-dimensional map of the magnetic signature of a small, mid-16th century Spanish ship lost on the lower Texas coast. The surviving artifactual materials were completely buried in the bottom sediments (From Clausen and Arnold, 1975).

Source: Coastal Environmental Inc. (1977).

b. Potential Impact on Cultural Resources by Sale No. 48

i. Impacts on the Southern California Bight: As discussed previously, oil spills appear to pose a minimal hazard to offshore cultural resources. Activities on the leases and along pipeline or cable routes pose the greatest hazard. Damage either to the resource or to the ability to discover it will arise from a failure to identify the resource and accurately locate it, or by ignoring indications of the resource and failing to safeguard the resource after discovery from unauthorized personnel. If no surveys are required in depths greater than 120 m (394 feet), then cultural resources in these deeper waters may be damaged or made undetectable. Even if the Supervisor should accept the need for surveys in deep waters, without relatively strong certainty concerning the existence of a cultural resource in the confines of a limited area, BLM would be reticent to request that one be conducted, because surveys in deep waters are difficult to conduct adequately and are consequently more expensive. Due to technical limitations and low incidence of occurring, the probability of detecting a shipwreck in deep water is much lower than for shallower waters. However, such a wreck, due to its enhanced state of preservation, would be extremely valuable. If a search were required and it was conducted within the latitude permitted by current survey standards there would be very low to nonexistent chance of discovering such a wreck, thus the resource may be lost.

Surveys conducted with due diligence in shallower waters and meeting current standards, could easily miss shipwrecks because of equipment limitations and the fact that even with the magnetometer towed 6 m (19.7 feet) or less from the bottom, sampling of only 25 or 30 percent of the survey area occurs in terms of detecting smaller, earlier wrecks.

In the following discussions by area, it should be borne in mind that wreck locational data varies from precise to extremely vague and that plotted location may vary according to the projection used. Therefore, wrecks reported near the boundary of a tract may, in actuality, be on the adjoining tract. Information concerning the degree of salvage, if any, is usually somewhat sketchy so that reported locations may be just simply locations which are devoid of evidence since the vessel was refloated or carried off by currents.

<u>Santa Barbara Channel Area Impacts</u>. In the western Santa Barbara Channel potentially significant wrecks are reported in tracts SBC-005 and 012. State waters from Point Conception to the vicinity of Tajiguas contain many wreck sites and numerous remote sensing targets

which are unidentified. In addition, 8 wrecks are reported as being in the general area of various shore points. Tracts in the vicinity of Point Conception having a higher probability of wrecks due to wrecks reported lost in the general area and because of the common occurrence of strong winds, currents and rough waters in the area are tracts SBC-003 through 006, 010-012, 015-017, 023-025, and 033-036. Activities on these tracts have a higher potential for adversely affecting shipwrecks. Pipelines coming to shore from any of these tracts in the western channel run a considerable risk of affecting potentially significant sites because of the density of reports and because the State of California does not presently require any type of cultural resource survey on its submerged marine lands. All tracts north and west of protraction block 74W 49N (OCS Leasing Map 6A) are potential contributors.

Tracts having high probability zones for aboriginal sites are SBC-004, 5, 6, and 011-012. Several marine sites have been reported in State waters from Naples, west to Government Point. They tend to be more concentrated in the western half of the region. Pipelines from all tracts in the northern half of the channel could pose a risk to aboriginal sites both known and undiscovered on State lands. Only the tracts identified are in shallow enough water to have much likelihood of aboriginal sites. The others constitute a much lower risk except that from pipelines.

In the vicinity of San Miguel Island, four wrecks are reported. These may have drifted to tracts 051, 052, 053, 054, or 079 but the probability is fairly low. Tracts 066, 067, 077 and 078 are somewhat higher risk. These wrecks reported lost in the vicinity of Santa Rosa Island cause tracts 080, 081, 082, 083, 084, 088, 089, 090, 091, 092, 098, 099, 100 and 101 to be somewhat higher in risk. Tracts 088, 089, 090, 091, 092, 093, 094, 098, 099, 100 and 101 are in high probability zones for aboriginal sites.

In the eastern channel tracts 046, 047, 063, 064, 065, 075, 076 and 087 rise in risk because of 9 vessels reported lost off Santa Barbara and 3 off Ventura. The number of wrecks known in State waters, decrease rapidly east of Santa Barbara. One is reported off that city and one between tract 087 and shore. Tracts 046, 047, 063, 064, 065, 075, 076 and 087 are in high probability zones for aboriginal sites.

San Pedro Bay Area Impacts. This area has been a natural port from ancient times and is also an area of relatively high sedimentation. It receives heavy shipping use currently and has had drilling for oil and gas in the past as well as currently. Consequently numerous anomalies are found with the magnetometer but there is often little or no associated surface evidence shown in side scan records to help explain the many anomalies. As a result, many anomalies which are detected have not been identified as to source, but attempts are made to avoid most of them. With current survey methods this situation can be expected to continue on proposed Sale No. 48 tracts and some cultural resources may be expected to be damaged or made more difficult to find again. Because of the proximity to large numbers of sport and commercial divers and convenient landmarks, cultural resources discovered on these tracts having their location disclosed by personnel hired by the operator to investigate anomalies, suffer a greatly increased risk of unauthorized salvage or pilferage.

Tract 123 has a potentially significant wreck reported on it. Tract 143 has another wreck reported a short distance inland from its boundary. There are literally dozens of wrecks of potential significance reported in the San Pedro general area. There are also numerous wrecks known to be within the harbor itself, which may be adversely affected by dredging, pipeline construction or other activities spawned as a result of this proposal.

Aboriginal high probability zones occur on Tracts 120, 121, 122, 123, 124, 125 and 126. Due to the sediment, presence of numerous vessels and some drill rigs, surveys may not detect aboriginal or shipwreck losses in these tracts as readily as they might in some other areas.

Dana Point - San Diego Area. There are no significant wrecks reported on either the Dana Point or San Diego tracts. There is one potentially significant wreck between tract 147 and shore, but in Federal waters. There are two in State waters opposite tracts 148-150 and two shoreward of tracts 151-153, one on the Federal OCS and one on State lands. There are 10 wrecks reported off Point Loma and 4 off the San Diego area. Tracts 164, 165 and 166 are higher probability areas as a result of these wrecks. The rest of the tracts are in a second level of probability zone for shipwrecks.

Aboriginal sites are unlikely on all of these tracts except a small portion of tract 164 and most of tract 165 which holds the relatively shallow Coronado Bank. Impacts on potential aboriginal resources on the tracts are unlikely except possibly tract 165.

Santa Rosa Area Impacts. There are no shipwrecks reported on these tracts, however, 3 were reported lost in the area of the south side of Santa Rosa Island. These would place tracts 109, 110 and 111 in an increased risk category. Portions of all of these tracts have high probability zones in them for aboriginal sites. Due to fewer potential shipwrecks, impact potential is lower on these tracts than some of the other areas.

Tanner-Cortes Area. There are no reported wrecks on the northern groups of tracts in this area. On tract 208 (Bishop Rock) are two reported wrecks which may be the same wreck reported twice. The wreck(s) is significant since it is an 18th Century Spanish galleon(s). An unidentified wreck is also reported on tract 210. Surveying in this area is complicated by the presence of high relief volcanic terrain, large breaking waves and strong currents. The volcanic rocks on Tanner Bank several kilometers to the north produce anomalies when they outcrop, which makes interpretation of records difficult. The same problems may be anticipated here. Due to the presence of very significant resources and potentially difficult surveying conditions, the impact potential of action on tract 208 is very high.

Areas in medium to high probability zones for aboriginal sites are found in tracts 174, 175, 177, 179, 182, 183, 187, 190, 191, 195, 196, 197, 198, 201, 203, 204, 205, 207, 208, 209, 210, 211, 212, 213, 214 and 215. Due to varying degrees of terrain relief and interspersed rocky outcrops and sediment areas, survey results are not always optimum. Therefore, adverse impacts could result even with well-conducted surveys and evaluation. Pipelines running up the ridge from this area to the Northern Channel Islands have some possibility of encountering shipwrecks or aboriginal sites. The ridge itself is relatively low for potential resources except where it reaches the island platforms.

Santa Barbara Island Area Impacts. No significant shipwrecks are reported lost on any of these tracts, but one is reported lost close to the boundaries of tracts 118 and 119, and two are reported lost in the vicinity of the island. This places all of the tracts in this area in a zone of increased probability for significant shipwrecks. Although no zones of high probability for aboriginal sites lie within these tracts, drilling on the eastern (shallow) portions of tracts 117 and 118 could result in anchors being placed in high probability zones outside the tracts and in State waters.

ii. Baja California Impacts: Since drilling and construction activities are the most likely cause of adverse impacts and oil spills are a minor potential source of impacts, there exists only a remote chance of adverse impacts to the submerged cultural resources of Mexican waters.

iii. Tankering Impacts: The only likelihood of tankering impacts is that an anchor might be placed upon or dragged through a site or that the tanker sinks and becomes an anomaly source which could mask nearby weaker anomalies. Tankers anchored near platforms while loading or waiting to load would present the greatest hazard to submerged sites if the area had not been adequately surveyed ahead of time. A secondary impact could be caused by constructing offshore loading/unloading facilities for tankers, if the pipeline route and site were not adequately surveyed and evaluated.

iv. Cumulative Impacts: Quantification of potential impacts is not possible without knowing the amount of the resource present and the efficacy which will be achieved in surveying for the resource. The selling of many leases in proposed Sale No. 48 will, however, in conjunction with existing leases, affect a significantly greater percentage of shallow water areas in the Southern California Bight. This greatly increases the potential for affecting possible submerged cultural resources.

7. Impact on Commercial Fisheries, Kelp Harvesting, and Mariculture: On a large scale the most significant of these are the commercial fishing operations. For a complete description of commercial fishing, harvesting operations, and mariculture within this area see Section III.G.2.d.i.

The interaction between offshore petroleum development (as exemplified by the proposed action) and commercial fishing, harvesting or mariculture are listed in Table III.C.7-1.

Table III.C.7-1

INTERACTIONS BETWEEN OFFSHORE PETROLEUM DEVELOPMENT AND COMMERCIAL FISHING OPERATIONS

At Sea	On Shore	Pollution
Loss of fishing space	Harbor space	Coastal effects
Obstructions and debris	Shore space	Physical interference from a major spill
	Marine services	
Navigation hazards and benefits	Labor market	Possible effects on fish stocks of:
	Capital	large spills
Emergency benefits	Social effects	chronic pollution

The most obvious conflict between the two industries will take place in a competition for space at sea. For the most part the offshore petroleum industry uses space passively (except for seismic work) while fishermen use space actively.

It is obvious that potential fishing space will be lost at all sites occupied by temporary or permanent drilling rigs or vessels, production platforms, subsea completions, and offshore storage or treatment facilities, and that these obstructions will need to be avoided by commercial fishermen. It is probably reasonable to assume that on

the average the offshore space removed from fishing is at least twice the area actually taken up by the obstruction.

Assuming that a safety zone of 1/4 nautical mile is maintained around each production platform (M.I.T., 1977), the area displaced by these structures is about 201 acres (0.24 sq nautical miles). The area displaced by an exploratory rig or vessel would be considerably more; 649 acres (0.77 sq nautical miles) assuming a 3,000 foot anchor radius and no fishing operations allowed within this area. If, at full development (not likely before 1985), there is a maximum of 27 new production platforms and a minimum of 5 exploratory rigs operating at any given time over the entire proposed lease area, the total area potentially excluded from commercial fishing would be on the order of 8,672 acres (10.2 sq nautical miles). This represents less than 1 percent of the total acreage offered in the proposed lease sale. The significance of the area actually lost, however, would depend upon the location of the structures and their spatial configuration.

Although it may not be as obvious as the potential conflicts over space many fishermen, especially in the Santa Barbara Channel area, commonly express concern that the petroleum industry may put subsurface obstructions and debris on the bottom which would damage nets and trawls. Such bottom debris, accidentally or intentionally discharged from petroleum industry related vessels or structures are expected to remain a source of much hositility and resentment directed toward the petroleum industry by local fishermen.

During all phases of offshore petroleum operations there will be daily encounters at sea with commercial fishing operations. In the early stages such encounters will mainly involve seismic ships, temporary exploration rigs or vessels, and support vessels. Later on there will be fixed platforms, subsea completions, ships or barges transporting oil to shore, and pipelaying ships.

Many of these encounters are expected to be nothing more than temporary nuisances (except for platforms) to commercial fishermen. Fixed platforms may actually provide benefits as navigational aids, potential sources of up-to-date weather and sea conditions and by providing emergency assistance to a disabled vessel or an injured crewman.

On shore conflicts between the petroleum and fishing industries will be discussed in more detail in Section III.E. Generally, considerable conflicts between the industries would occur if offshore petroleum operations are based in the smaller fishing ports (e.g. Santa Barbara, Port Hueneme, Oceanside) rather than the larger more "industrialized" ports (e.g. Los Angeles-Long Beach Harbor, San Diego Harbor).

Potential impacts to commercial fishing due to oil pollution can occur in several ways: 1) due to pollution in coastal areas caused by the transportation of new offshore oil to land; 2) the effects of oil pollution on fish stocks; and 3) the catastrophic event of a large oil spill (1,000 bbl or more) in traditional fishing grounds.

Transportation may or may not increase the probability of pollution in coastal areas of Southern California. This, of course, would depend upon how much crude oil shipping either increased or decreased within the area (see Section III.4.a).

The effects of oil pollution on fish stocks have been discussed in Section III.C.1.c.

Probably the greatest pollution threat to commercial fishing activities would come in the event of a large spill within traditional fishing grounds. In such a case the presence of a large spill in a fishing area would clearly prevent or at least limit commercial fishing operations for a period of time during and after the spill. In this case the magnitude of the impact to commercial fishing would depend upon the type of oil spilled, the frequency and the size of the spill, the time taken for cleanup operations, and the length of time required for sufficient dispersal and weathering of that part of the spill not cleaned up. In the case of the Santa Barbara spill of 1969 it is estimated that local fishermen lost a minimum of two months of fishing within the area affected by the spill (Neal and Sorensen, 1970). The placing of an oil boom across the mouth of the Santa Barbara Harbor along with the reluctance of fishermen to operate in oiled waters for fear of oiling fishing gear and boats are the main reasons for this loss in fishing effort. Boats which were not "locked" in port from the oil boom were forced to move to other fishing grounds resulting in greater operating costs for the fishermen.

Kelp harvesting operations may be affected by offshore petroleum development in much the same way as commercial fishing. An exception would be that bottom obstructions and debris would not present a hazard. The effects of oil on kelp itself are discussed in Section III.C.1.g. A large spill would impact kelp harvesting operations by making an area unsuitable for harvesting because of the possible damages and oiling of the mechanical harvesters.

Mariculture operations are most likely to receive significant impacts due to an oil spill encroaching upon the area of operations. Because of the relatively concentrated activity a spill would have very significant impacts upon mariculture operations.

a. Impacts on Southern California Bight: The preceding discussion has addressed general impacts upon commercial

fishing, kelp harvesting and mariculture which may occur as a result of offshore petroleum development. Brief discussions of impacts specific to the six subdivisions of the Southern California sale area follow:

i. Santa Barbara Channel Area Impacts: Bottom trawl fishing within the Southern California Bight occurs almost exclusively within the Santa Barbara Channel area. This type of fishing is perhaps the most susceptible to conflicts with offshore petroleum development. All sites occupied by drilling rigs or vessels and/or production platforms will need to be avoided by trawlers (see previous discussion for areas usurped). Bottom debris accidentally or intentionally lost over the side of vessels or platforms are of major concern to Santa Barbara based trawlers. Although petroleum industry related vessels may not be entirely responsible for these obstructions they often receive the brunt of hostility and resentment from fishermen unfortunate enough to snag them. The Santa Barbara trawl grounds and therefore the area of greatest potential conflict are illustrated in Figure III.C.7-1.

Purse seine operations for pelagic species (mainly northern anchovy) are also an important component of the Santa Barbara Channel area. Many of the same conflicts as those described for trawlers apply to these operations. Bottom obstructions do not provide the degree of possible impacts as they do to trawlers, although in shallow waters (200 feet or less) these obstructions may snag nets.

Attempts to quantify fisheries losses from a hypothetical oil spill can be difficult and misleading because of the many variables involved. In an economic evaluation of the loss in commercial fish catch due to the Santa Barbara oil spill, Mead and Sorensen (1970) estimated a loss of $66,750 in catch alone. Including estimated losses in income and uncompensated damages to the fishing fleet this spill represented a total loss of $804,250 to the fishing industry.

Similar estimates of losses to commercial fishing due to chronic pollution resulting from numerous small spills and/or discharges from platforms are extremely difficult, if not impossible, to make. These types of chronic discharge, when combined with continuing natural seepage, existing leases and tanker traffic may result in rather significant impacts over the long term of offshore oil development.

ii. San Pedro Bay Area Impacts: The area of San Pedro Bay and the Catalina Channel are the largest producing commercial fishing ground within the Southern California Bight (Visual No. 6). Almost extensively fished with purse seines the principle target species is the northern anchovy. Within 3 nautical miles of the mainland and the northeast side of Santa Catalina Island

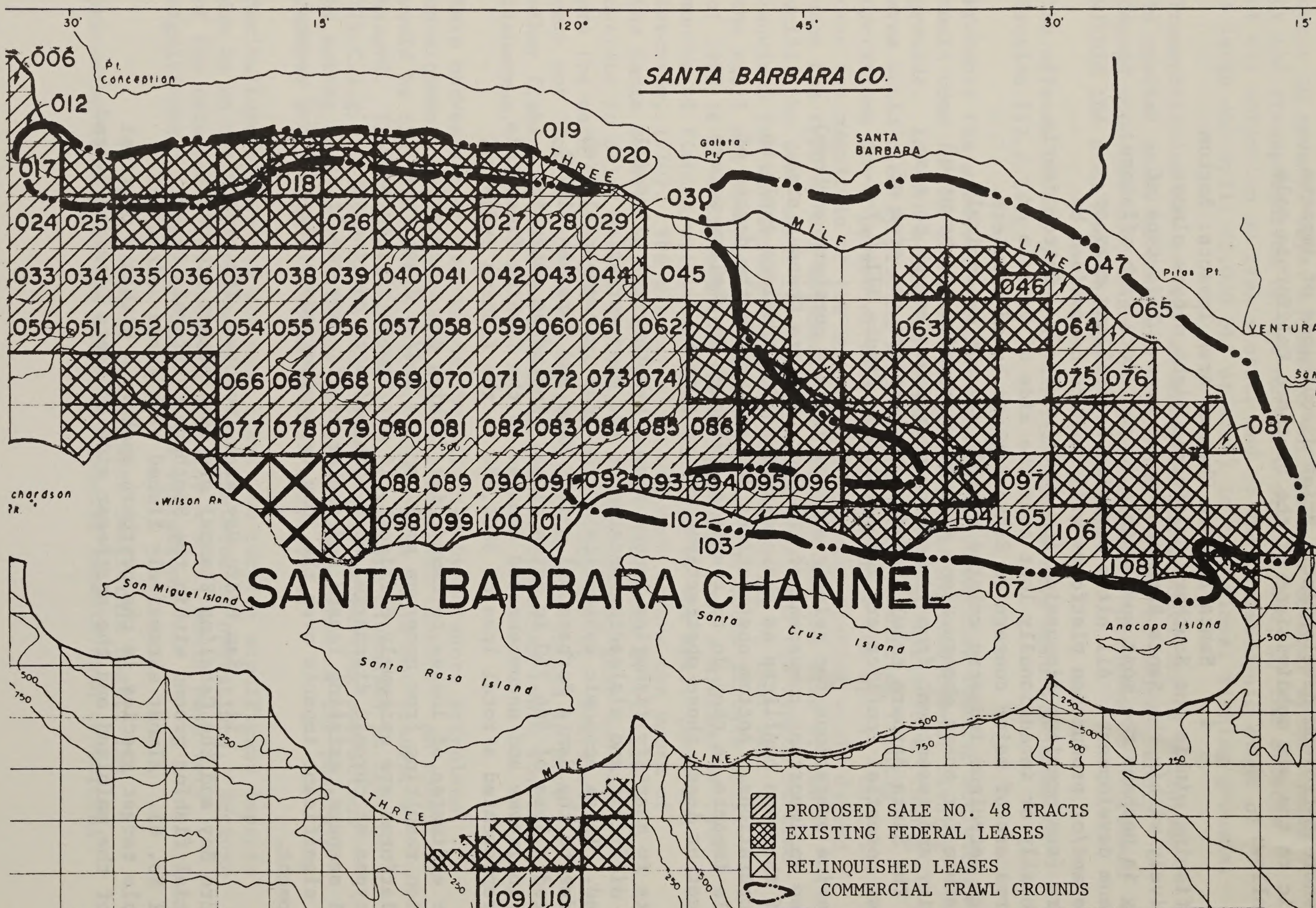


Figure III.C.7-1 Santa Barbara Channel Trawl Areas.

commercial reduction fishing for anchovy is prohibited. Instead anchovy are fished by live-bait fishermen using a forerunner of the purse seine, the lampara net. Although live-bait fishing may occur year-round, reduction fishing is limited to the period between September 15 and May 15. During peak periods weekly landings in the reduction fishing may reach 8,675 short tons (17,350,000 pounds) representing a dockside value of $303,625 (based on 1976 prices: Dept. Commerce, 1978). Throughout the season average weekly landings may be only 4,406 short tons (8,812,000 pounds) representing a value of $154,210. Non-reduction fisheries for anchovy in this area may average about 8.3 percent of the total catch. Although these landings are considerably less, the live-bait catch is generally more valuable per ton than the reduction catch.

Many of the "at sea" conflicts between offshore oil development and commercial fishing operations in this area are the same as those previously described. A possible exception would be hazards due to bottom obstruction and/or debris. Generally, these types of conflicts are not as significant as they are for the trawlers.

Onshore conflicts and affects of pollution would be the same as those described previously.

Probably the most significant impacts would result from a large spill occurring within the rather enclosed area of San Pedro Bay. Although impacts upon the fishery stocks themselves may be rather insignificant (see Section III.C) the hinderance of fishing on traditional grounds may be significant. Assuming the worst case, a spill resulting in the loss of two months of fishing during peak periods may represent a loss of as much as dollars to the fishing industry from catch alone.

iii. Dana Point-San Diego Area Impacts: The principal commercial fishing activities within this area are similar to those just described for the San Pedro area. Impacts would, therefore, be similar. The main areas of concern occur between Dana Point and Oceanside and from Del Mar to the Mexican border. The latter area receives the greatest effort from commercial fishermen.

Again, the major threat to commercial fishing operations would be a result of a catastrophic spill. As mentioned previously these are expected to be temporary although they may represent significant short-term impacts upon the commercial fishing industry.

iv. Santa Rosa Area Impacts: This area does not receive the degree of commercial fishing activity as do the more coastal areas. Therefore, impacts to commercial fishing are expected to be mimimal.

v. Tanner-Cortes Area Impacts: This area is the most significant offshore area for commercial fisheries within the Southern California Bight (see Visual No. 6). Jack mackerel, rockfish, abalone, and the hydrocoral Allopora californica are the principal target species. Most of the fishing effort is confined to the relatively shallow waters of these Banks (less than 95 meters (300 feet)) with commercial abalone and coral harvesting occurring in depths of less than 30 meters (100 feet) (Figure III.C.7-2). Because of the relatively small area encompassed by these fishing grounds, conflicts over space at sea could become a significant issue. At least 14 tracts proposed for this lease sale are either partially or wholly within the limits of the fishing grounds. Using the most probable estimates it is likely that as many as 9 production platforms could be placed on the banks along with 28 subsea completions. Considering the relatively small area of the banks and the commercial fishing grounds significant losses of available fishing space may occur.

Impacts to abalone and coral harvesting may be even greater due to the very limited area of the fishing grounds and the reluctance of the petroleum industry to allow diving close to temporary or permanent structures.

Bottom obstructions and debris are not expected to significantly impact commercial fishing operations with this area.

Because these banks are located about 100 miles offshore the presence of surface structures may actually serve as navigational aids to fishermen. However, the configuration of such structures may play an important role in determining their possible impacts as hazards or aids.

Because of current conditions on the banks closely spaced structures may, in fact, prove hazardous to purse seine operations, such as employed in the jack mackerel fishery. However, even at a density of 1 platform per lease tract such hazards are not expected to significantly affect fishing operations.

Permanent or semi-permanent structures could also prove of great benefit to fishermen in emergency situations. This is especially true to the abalone divers and coral harvesters fishing the banks in small boats with one or two-man crews. A structure on the banks equipped with a helicopter pad could become a valuable asset should the need arise for quick evacuation of an injured diver or crewman to onshore medical facilities.

At this time sufficient information is available to identify these banks as a unique area within the Southern California Bight. However, our understanding of the banks, at this point, is not sufficient

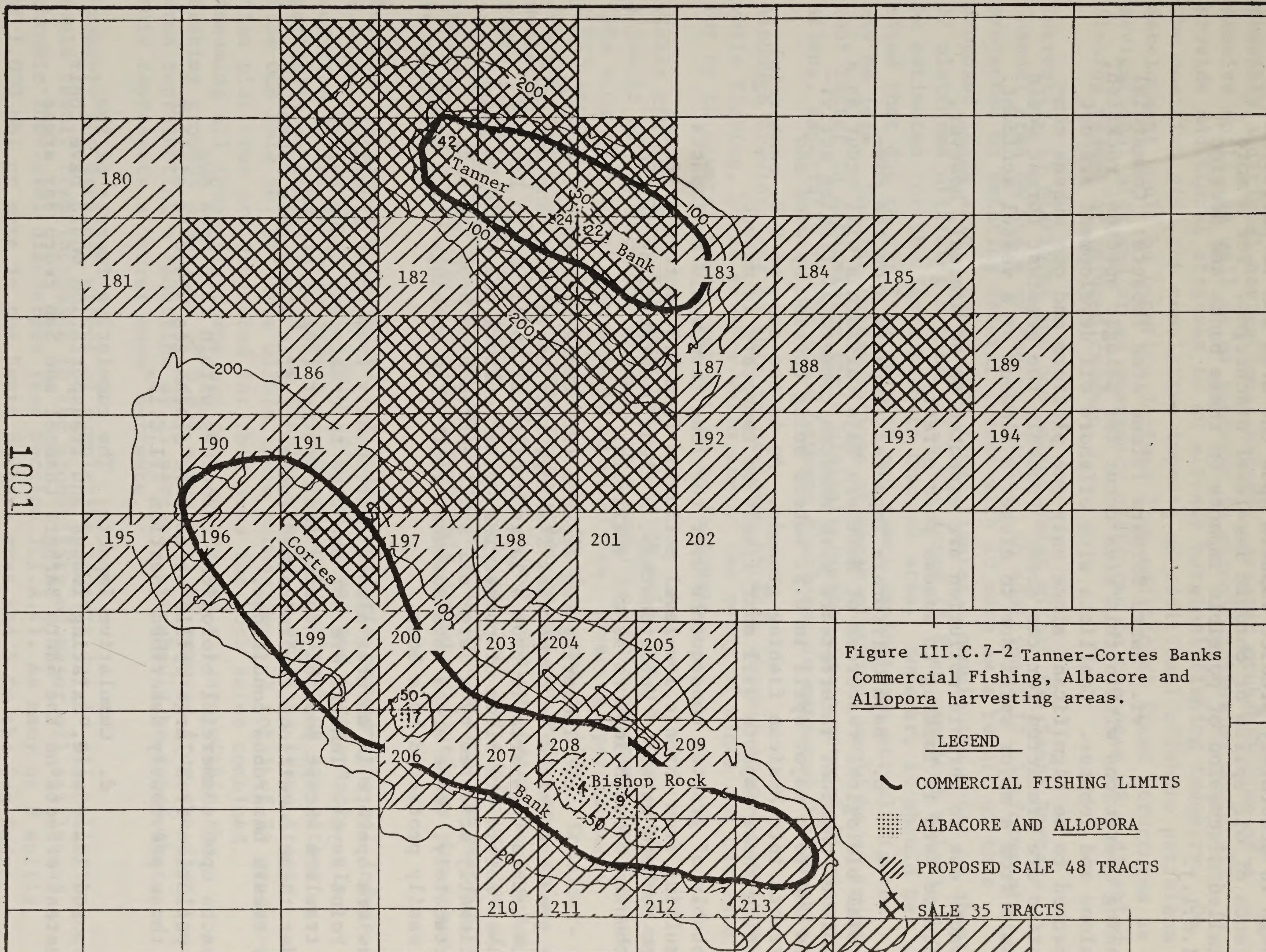


Figure III.C.7-2 Tanner-Cortes Banks Commercial Fishing, Albacore and *Allopora* harvesting areas.

enough to accurately predict impacts upon the area due to pollution effects of oil spills or chronic low-level discharges. For a more detailed discussion of possible impacts on these banks see Section III.C.1.j.

vi. Santa Barbara Island Area Impacts: Commercial fishing operations within this area occur for pelagic species, rockfish, abalone and lobster. Conflicts with offshore oil development are not expected to be significant since only one platform and one subsea completion are predicted for the area. Probably the greatest threat would result from a major spill due to either a blowout or a vessel accident.

Impacts due to chronic pollution are expected to be minimal, however, adequate data is lacking to assess such effects.

b. Baja California Impacts: Impacts upon the commercial biological resources of Northern Baja California will occur as a result of physical interference with Mexican commercial fishing activities due to a major spill in U.S. waters being carried by wind and currents into Mexican fishing grounds. As in the case of U.S. commercial fishing these impacts will most likely be temporary in nature.

Probably of greater consequence over the long term would be impacts resulting from chronic low-level pollution from U.S. waters drifting into Mexican waters. Unfortunately, a clear understanding of the mechanism of such impacts is not available.

c. Tankering Leg Impacts (Pt. Conception to Pt. Reyes): The greatest hazard to commercial fishing, kelp harvesting, and mariculture within this area is from a large accidental spill. Morro Bay and Drakes Estero are sites of commercial oyster culture and would be significantly affected by a large oil spill encroaching upon the beds. Fortunately, these areas have somewhat restricted openings which could be easily protected by a boom.

Trawlers operate in an area almost continuously from Point Arguello to Point Reyes. Tankers are not expected to create any undue hazard to trawlers except possibly during foul weather (fog or storms). Under these conditions the increased tanker traffic along this route may create hazardous conditions.

Impacts upon commercial biological resources within this area due to pollution from large spills or chronic discharges would be similar to those previously described (Section III.C.1).

d. Cumulative Impacts: The cumulative impacts of the proposed lease sale, existing leases and transportation would have their greatest effects on the Santa Barbara Channel and San Pedro Bay areas.

Loss of fishing space, increases in bottom obstructions and debris, possibly additional navigational hazards, greater probabilities of a massive spill, as well as an increase in chronic pollution would all provide additional stresses to an already marginal fishing industry. On the positive side, the cumulative impacts of additional offshore petroleum development would be benefits derived from additional fixed structures as navigational aids and/or as emergency platforms in the case of a disabled fishing vessel or injured crewman.

Currently, 15 platforms and one island exist within the Santa Barbara Channel area on State or Federal lands. An additional 12 platforms are projected on existing Federal leases with 10 more as a result of this proposed lease sale. Based upon these figures, a cumulative total of about 37 platforms utilizing a total of 7,437 acres (8.8 sq nautical miles), can be estimated for the Santa Barbara Channel area. However, it should be noted that due to drilling results and tract expirations actual figures may be less. Spatial configurations of these platforms would be an important factor in determining their ultimate impacts on commercial fishing operations, especially if the space between platforms is rendered "unfishable."

Although trawlers may be able to navigate between closely spaced platforms while fishing, purse seiners which are at the mercy of winds and currents for up to several hours, may not be as fortunate.

Within the San Pedro Bay area, two platforms exist with 8 more estimated as a result of OCS Sale No. 35 and 3 as a result of this proposed lease sale. This adds to a total estimate of 13 platforms, covering approximately 2,613 acres (3.1 sq nautical miles), within this area by 1986. Considering the rather concentrated area represented by the San Pedro area this number of platforms could provide a significant physical hazard to the San Pedro fishing fleet. Of course, as mentioned earlier, the configuration of these structures would play an important role in determining the eventual impacts. It is possible, however, that this number of platforms may never be achieved.

Perhaps the greatest potential for space conflicts between the oil industry and commercial fishing would occur on Tanner and Cortes Banks. In addition to the 14 lease tracts of the proposed sale which are either partially or wholly within the fishing ground, 6 existing lease tracts from OCS Sale No. 35 occur within these boundaries. A total of 34 production platforms are projected for this area for both sales combined. Assuming all these platforms are constructed and all are within the fishing grounds a maximum of 6,834 acres will be removed from the fishing area representing a reduction of 15 percent. It should be noted that this represents a "worst case" estimate.

Probably the greatest effect of cumulative impacts due to oil pollution would result from increases in the probability of major oil spills and chronic low-level discharges (see Section III.A.4). As many as 9 spills of 1,000 bbl or more in the Santa Barbara area and 5 in the San Pedro

Bay area are expected from the cumulative effects of existing leases, the proposed lease sale and transportation between 1976 and the year 2000. Assuming two months of fishing effort are lost as a result of such spill, as many as 18 months may be lost in the Santa Barbara Channel area and 10 months in the San Pedro area. Of course, these estimates assume that the fishermen do not move to different areas to fish.

e. Conclusions: The major environmental impacts on commercial fishing activities resulting from the proposed sale will be: 1) the loss of fishing space, 2) damage to fishing gear due to bottom obstructions and debris, and 3) the loss of income and physical interference of fishing activities due to a major spill over fishing grounds.

Approximately 201 acres (0.24 square nautical miles) of available fishing space will be lost for each permanent platform erected and 649 acres (0.77 square nautical miles) for each exploratory rig or vessel. The total area estimated to be withdrawn from commercial fishing as a result of the proposed action and cumulative total for existing oil and gas leases are shown in Table III.C.7-2. However, actual figures are expected to be somewhat less.

This loss of fishing space will have its greatest effect on the Santa Barbara Channel Area and Tanner-Cortes Banks Area leases (see previous discussion).

Damage to fishing gear due to bottom obstructions and debris will have its greatest effects in the Santa Barbara Channel area, especially on trawl grounds (Figure III.C.7-1). Such losses may amount to several thousand dollars, and, while irritating to the fishermen, are not expected to reach significant economic levels.

At least one major spill (greater than 1,000 bbl) is expected during the life of the proposed action. This will result in the loss of as much as 2 months of fishing effort within the effected area. This could represent an economic loss of as much as $800,000 to the commercial fishing industry.

Table III.C.7-2

ESTIMATES OF THE POSSIBLE FISHING AREA FORGONE AS A RESULT OF THE PROPOSED LEASE SALE AND EXISTING OIL AND GAS LEASES

Lease Area	Sale No. 48 No. of Platforms	Sale No. 48 Acreage	Cumulative No. of Platforms	Cumulative Acreage
Santa Barbara Channel	10	2,010	37	7,437
Santa Rosa	1	201	3	603
Santa Barbara Island	1	201	4	804
San Pedro Bay	3	603	13	2,613
Dana Point-San Diego	3	603	3	603
Tanner-Cortes Bank	9	1,809	34	6,834
Totals	27	5,427	91	18,894

8. Impact on Sport Fishing and Recreational Boating: In addition to sport fishing, recreational boaters cruise, ski, race, and sail. A rough correlation exists between boat length and the type of use to which it is put. As an example, California boaters did most of their water skiing in boats ranging between 4.3 and 7.9 m (14 and 26 feet) (Arthur Young & Co., 1973) while boats exceeding 7.9 m (26 feet) were used predominantly for cruising and sailing, with skiing declining to a minimum. The percentage of total California registered boats in the south coastal region ranges from 50 percent for 6.4 to 7.9 m (21 to 26 foot) boats, to 57 percent for boats 9.4 m (31 feet) and over. Eighty percent of all boating exceeding 7.9 m (26 feet) occurs in coastal waters and bays with only 20 percent of boats less than 5.5 m (18 feet) utilizing these same waters. Boating activity in coastal waters is primarily sailing, cruising, racing and fishing. There are no data which further refine the kinds of sub-activity and perceptions which are associated with sailing and cruising or the time spent and numbers of persons involved with them. Therefore, there is no quantification of some of the impact potential associated with this proposal.

a. Impacts on the Southern California Bight: Impacts on boating will come from spills, both chronic (small) and catastrophic, from structures, and from activities, like workboats and pipeline construction. The most probable and major impacts would be from large spills. Boaters (including sport fishermen) would carefully avoid areas of large oil spills but may be affected by small patches from chronic low-level spillage and by oil from large spills which enters the harbors prior to protective booms being installed. Harbor closures due to the installation of booms across the entrances prevent passage by vessels unless a bubble curtain boom is used.

Structures can have both positive and negative impacts. Their presence prevents the use of a limited area of ocean and, if densely located, may interfere with sailing or racing. Some incidences of collisions or accidents involving recreational boaters with platforms have occurred in the Gulf of Mexico. The accident rate is very low, however. The positive benefit is that the structures serve as an aid to navigation. They make excellent radar reflectors for radar-equipped boats, and are positively located positions suitable for navigation, either by radar or visual observation. They also have provided shelter, aid and communications for boaters who are lost or sustained damage, breakdowns, or fuel exhaustion.

In addition, sport fishing may actually be increased by fish population enhancement due to the artificial reef effect of offshore platforms. In the open sea, platforms provide both food and cover in areas that otherwise are largely devoid of these essentials. While it cannot be denied

that platforms enhance fish populations the actual benefits to sport fishermen are questionable. Sportsmen are prohibited from actually "tieing-up" to a platform to fish beneath it. Also, although not strictly prohibited, many companies make it a general practice to discourage sport fishermen from anchoring or otherwise floating less than about two hundred feet from a platform (H. Wright, WOGA, personal communication, 1978).

Increased workboat traffic in harbor areas and approach lanes will provide some competition with recreational boaters where harbor facilities are shared with industrial boats. Traffic congestion in the vicinity of the harbors could increase appreciably, particularly in conjunction with that generated from existing leases. This would create problems for boaters going to and from the facility with their trailered boats, or driving to and from their moored craft. Increased demand for commercial harbor facilities may result in loss of slips and moorings for recreational boats or a slight reduction in boat sales. However, harbor improvement could become feasible as a result of greater need.

Disruptions created in marinas and harbors, by supply boats and barges, would be less during the production phase than during the development stage. If pipelining is chosen to bring oil ashore, then impacts due to transportation will be minimal but if barging is chosen, then increased traffic and harbor congestion will continue to impact recreational boaters.

Many local boaters may find platforms to be undesirable. Their lines (unless disguised as in the THUMS project near Long Beach) are discordant features on the flat plane of the sea and their presence constitutes an alteration of the normal solitude which exists on the open sea.

Alteration of water quality by chronic minor discharges may affect the quality of fish (see Section III.C.1.c.) caught by sportsmen in these areas and may reduce some people's enjoyment of the boating experience when tar balls or slicks are present, or the water appears to be "not as clean". Pipeline construction could result in short-term alteration of water quality by increasing turbidity. If a discharge reduces local faunal assemblages, then this would be a temporary negative impact on boaters who use the resource for fishing or just observation.

In summary, in the event of a major oil discharge, some loss of values can be expected wherever the slick intercepts a sport fishing or recreational boating use area. Sportsmen and other boaters can be expected to avoid the area. However, if the slick was encountered, boats would probably be damaged by staining. Harbor closures, as happened at Santa Barbara during the 1969 spill, will preclude people from using their boats. Small slicks from platforms or vessels associated with the oil industry will cause esthetic degradation as will temporary turbidity increases because of pipeline installation or drilling activities.

Santa Barbara Channel Area Impacts. Boaters utilize the waters near the Santa Barbara Harbor entrance for local boating, but many cross the Channel to Santa Cruz Island and the other northern islands. Visuals No. 4 and 5 show the sections within this area most utilized by recreational boaters and sport fishermen, respectively. The 1969 oil spill can demonstrate to a degree, what might be expected to result from a medium to major discharge from this proposed activity. During the 1969 spill, a boom remained across the harbor entrance to keep oil out of the harbor. Boats were precluded from coming or going during that time. On February 27, the boom was replaced by a bubble curtain which permitted passage, again. Department of Navigation and Ocean Development (DNOD) data indicate an average annual use of 28.4 days for all south coastal region boats (Arthur Young, 1973). For all California boats, the average annual use was 43.3 days for boats in the 6.4 to less than 7.9 m (21 to less than 26 foot) class, rising to 53.8 days for 7.9 to less than 9.4 m (26 to less than 31 foot) class. Since the larger boats are used more frequently in the ocean than smaller ones, the greater annual use figures are probably most representative of Santa Barbara area boaters.

During the discharge, considering only berthed or moored boats, a harbor closure of 1 month would result in a loss of 1,830 boat-days of use at an average annual use of 28.4 days. At the higher figure of 53.8 days, a loss of 3,462 boat days would occur. Oil from the Santa Barbara discharge continued hampering commercial fishing, causing many operators to move out of the area (temporarily) in April (Mead and Sorensen, 1970). Oil which discouraged the fishermen, undoubtedly caused a parallel reduction in recreational boating. Assuming a minimum 50 percent reduction in boater activity for March and April gives a further reduction of 3,660 to 6,924 boat days.

A major oil spill would most likely affect fishing adversely although temporarily. Boat fishermen would not want to soil their boats by fishing in the vicinity of an oil slick and neither boat nor surf fishermen would want to keep fish that had been coated or contaminated with oil. Therefore sport fishing would be curtailed in the vicinity and for the duration of the spill incident. This would not preclude fishing in alternate areas even though the catches there might be lower.

According to the California Department of Fish and Game (1969) the number of fish taken from partyboats operating out of Santa Barbara very definitely declined during the blowout of 1969. During the 6-month period, February-July 1969, reported landings were only 10% the size of those for the previous four years for a comparable period and it is probably valid to estimate a similar decline for sport boats. The major portion of this decline can unhesitatingly be attributed to lack of fishing effort. Because of the adverse publicity of the oil spill, sportsmen fished elsewhere. The total number of boat days during the six month period was only 13% of the average fishing effort for a comparable

period during the previous four years. Only 723 sport fishermen used partyboat facilities at Santa Barbara during this period in 1969, while 5,693 used them in 1968. A comparison of sport catch to fishing effort during the six month period, reveals that the catch per fisherman day was 6.7 in 1969 compared to 8.9 in 1968. Catch data from 1965 indicate the catch per angler day fluctuates widely in the area, but was slightly lower than average on the Santa Barbara partyboats in 1969.

Impacts on surf, shoreline, and private boat fishing can only be predicted from those observed for partyboats during the 1969 Santa Barbara Spill. That is to say that, at least temporarily, fishermen would avoid those areas affected by spilled oil.

Because of the circular current regime in the Santa Barbara Channel, residence time and geographic exposure of spilled oil would be protracted and widespread. Even if harbors remained open, little area would be safely oil-free enough to permit boating in the event of a major discharge.

Impacts on the Ventura-Oxnard area would amount to a loss of 3,385 to 6,412 boat-days for the same type of situation with 30 days duration.

Proposed Sale No. 48 risks indicate that 2.6 spills would result from the project. Existing leases could account for 8.7. The total for Sale No. 48 combined with existing leases and oil being transported through is 12.9 spills. For a 30-day duration spill in the "most likely" scenario, the Ventura shoreline stands the highest risks with a 15 percent chance of at least one large spill from the proposed sale, a 26 percent risk from existing leases and a 37 percent chance from all considered sources. The greatest risk arises from existing and proposed tracts in the eastern Channel.

San Pedro Area Impacts. Impacts may occur from structures and vessels on leases in this area and from spills originating in this lease area.

The nearshore and Catalina Channel-Catalina Island waters are among the most heavily utilized ocean boating areas of California. Major sport fishing areas are shown in Visual No. 5. Numerous marinas and anchorages surrounding Catalina Island and the shoreline south from Los Angeles-Long Beach Harbor could be closed in the event of a major discharge. It is unlikely that the Los Angeles-Long Beach Harbor complex would be closed so the area within the breakwater would remain available for limited boating though with some risk of oil soiling. Closure of the harbor to recreational boating would result in a loss of 6,500 boat-days. At the same time, about 5,200 boat-days would be lost at the Alamitos-Anaheim Bay complexes. Newport Bay is a large complex which permits limited boating within the harbor itself; however, it is unlikely that craft in excess of 7.9 m (26 feet) would be utilized extensively in these waters. The loss per large event would be 10,000 boat-days. The most damaging discharges for this region would come from tracts in the

near offshore and to the west and northwest of the harbors and boating areas. Lesser impact potential comes from tracts in the Santa Rosa-Cortes North and eastern Santa Barbara Channel. Discharges originating in the Santa Barbara Island area are close enough to constitute a hazard, while the other two areas would probably produce only tar balls due to distance.

Proposed Sale No. 48 risks indicate that 1.3 spills would result from the project. Existing leases along with other oil being transported in the area increase the total to 4.9 spills. A 16 percent chance exists of one or more large spills, striking land in the San Pedro Bay area from all sources considered in the "most likely" scenario. The tracts from proposed and existing leases in San Pedro Bay, south to Dana Point constitute the greatest risks.

Dana Point-San Diego Area Impacts. Three groups of tracts (141-166) may most directly affect boating and sport fishing in this region. Other groups of tracts possibly affecting this region by spillage are San Pedro, Santa Barbara Island, Santa Rosa-Cortes and Tanner-Cortes in descending order.

Dana Point is directly opposite tracts 141-146 and very likely to be affected by any spills on them. Discharges from San Pedro tracts could also reach the harbor quickly. Impact for a spill lasting 15 days would be 1,600 boat-days.

Tracts 147 to 153 lie directly offshore of Oceanside Harbor. A 15-day closure would produce a loss of 887 boat-days.

Mission Bay, destined to become the world's largest marina upon completion of development, provides large areas of open water for boating within the bay. Without control measures, spilled oil could penetrate into the bay, but with a lack of data concerning the number of boats entering or leaving the bay, it is difficult to arrive at impact figures. Assuming that in the event of a spill, half of the boaters would still desire to go out of the bay, the impact would equal 1,400 boat-days. If oil penetrated deeply into the bay, then the boat-days loss would double plus a substantial increase in damage due to oiling of craft and time lost while being repaired. Tracts 154 to 166 are the nearest tracts to Mission Bay. Spills on tracts 154 to 159 are most likely to affect the bay in the event of a spill on them.

Tracts 154 to 166 are closest to San Diego Bay and most likely to affect its boaters in the event of a spill. This bay, like Mission Bay, has large areas of boating water within the bay, thus complicating impact analysis. Assuming that 50 percent of the use would be affected, the impact would be 2,060 boat-days.

Somewhat unique to this area are several areas of "big game" fishing for swordfish, striped marlin, and bluefin tuna (see Visual No. 6). These fish occur regularly at the surface (especially swordfish and marlin) and would be extremely vulnerable to a major spill. Although it is unlikely that mortalities would occur, a large spill would most likely drive these fish to other areas perhaps less accessible to sportsmen. Chronic small spills or discharges may render these areas less desirable to these species, severely altering the sport fishery. All tracts of the proposed lease sale in the area are either entirely within these fishing areas (Tracts 154-166), partially or within close proximity to these areas. Perhaps the most significant area is that between La Jolla to the Coronados from the near inshore waters to about 15 miles offshore.

In summary, the combination of proposed Sale No. 48 risks with existing leasing and foreseeable transportation is a 16 percent chance of a spill contacting the area's coastline within 30 days. Proposed Sale No. 48 accounts for 7 percent of the risks while existing leases add 9 percent. Spill risks are minimal at 0.1 of an event.

Santa Rosa-Cortes Area Impacts. No use figures are available, but many mainland boaters use the waters around the northern Channel Islands for cruising, camping, fishing and diving. Most winds and currents trend southeasterly from the islands; therefore, spills from these tracts are less of a potential hazard than their proximity indicates. Spills from the Santa Barbara Channel tracts are more likely to impact boating in this area. Structures would be far enough offshore that they would cause little interference with recreational boaters who are unlikely to venture very far south of the islands in most cases. Boating impact potential is relatively low for these tracts, but they do provide some risk to boating around Santa Barbara, Catalina and San Clemente Islands.

Tanner-Cortes Area. These banks are far offshore and not readily located by the inexperienced, therefore, are not often visited by the casual boater. The area would be most affected only by spills originating from tracts on the banks themselves with some degree of risk coming from the Santa Rosa-Cortes area. Impact potential to recreational boaters and sport fishermen is low because of limited use. The location of structures on the area would make navigation location easier, as well as increase the navigation. Greater use could then cause increased pressure on the biologic resources.

Santa Barbara Island. Santa Barbara Island and waters, a part of Channel Islands National Monument, receive moderate boater use. This area along with the Osborn Bank area just south of it are also popular sport fishing grounds. An uncontained discharges from tracts located near the island are likely to enter its waters as it lies downcurrent from the tracts. Visitation is about 10,000 annually and a 15 day spill would result in a loss of 411 visitor-days. It is likely that a large spill would cause sufficient actual or perceived depreciation of the island's resources to result in a major decline in visitation amounting to 80 percent or more for the year following the spill. This would be a loss of 8,000 visitor-days.

Baja California. No use data and limited data on harbors were available. Baja waters, ports, islands and anchorages are, however, popular with American boaters and sport fishermen. The major port is Ensenada, but other smaller ports are scattered down the coast. Spills primarily from Tanner-Cortes will reach the Baja coast if not contained. In the winter some risk of spills reaching the Baja coast from San Diego, Oceanside and San Pedro Bay tracts exists. Quantitative impacts are impossible to derive with the available data. Boating areas from the Border south were not digitized in the spill model analysis. Fairly heavy boating use exists south to Ensenada and lighter southerly, therefrom. Impacts are small except for the tracts off San Diego which could produce damaging spills almost as far as Ensenada. The risk of a spill occurring on these tracts is small, however.

Central and Northern California. Sport fishing and recreational boating impacts in this region may come from tanker spills either through normal "chronic" losses or major discharges. In the more southerly portion, spills from tracts in the western Santa Barbara Channel may reach boating areas. Pillar Point Harbor in Half Moon Bay has 250 existing and 450 planned slips. A spill lasting 15 to 30 days from a tanker would cause an impact of 290 boat-days. With completion of expansion and a 30 day spill, the impact would be 1,630 boat-days. Santa Cruz Harbor with 900 berths, Moss Landing, Stillwater Cove and Monterey Marina, all in Monterey Bay, have a total of 850 berths or moors. A spill which washed into Monterey Bay from sea lanes offshore and persisting for 15 to 30 days would result in losses of 1,050 to 2,100 boat-days at Santa Cruz, and 990 to 1,920 boat-days for the remainder of the Bay. If the entire bay was affected, which is unlikely, the range could be 2,000 to 4,000 boat-days.

Existing leases pose a maximum risk of 12 percent north of Point Conception, for individual shoreline segments. Proposed Sale No. 48 adds less than a 5 percent risk, for shoreline segments and that arises from the westernmost tracts in the Santa Barbara Channel. Most of the risk arises from passing tankers and not from leases. Segments 40-43 (Monterey Bay to the Golden Gate) run risks of as high as 30 percent (Segment 42) of being impacted should a spill start on the adjacent tanker route. Boating resources north of Point Conception were not digitized and, thus, are not analyzed in the overall discussion.

Estero Bay with Port San Luis and Morro Bay would have an impact of 140 to 410 boat-days, respectively, for a 15 day duration spill; while a 30 day spill would range in impact from 280 to 820 boat-days.

Summary and Cumulative Impacts. The oil spill model received from the USGS, Reston Virginia, computes the probability of a spill starting from a particular location reaching a resource category. Table III.C.8-1 ranks the source areas by percent chance of contacting a high density recreational boating area.

Table III.C.8-1

RANKING OF SOURCE AREAS

	Percent Chance				
	100-95	95-75	75-50	50-25	25-10
P	4, 5, 6 7, 8, 9, 17, 18, 19, 20, 21, 22, 23	3	11,12	2	10
E	1, 3, 4 5, 6 12, 13		2	7,9	8
T	6, 7, 8		5		
L	4, 5, 6	3,8		7	2

(Table III.C.8-1 shows percent chance that given a spill occurring at particular sources, it will reach a high density recreational boating area[a] within 60 days. P,E,T and L refer, respectively, to proposed (Sale No. 48) leases, existing leases, tanker legs and pipeline legs. These are shown in Figures III.A.4.b.i.3 and 5. Less than 10 percent chances are not tallied).

Table III.C.8-1 shows only that given a spill, which source areas constitute the greatest risk to the boating resource. The probability of a spill actually occurring on any particular source area is based upon the expected volume of resource at that area. Similarly, the source of spills is distributed randomly over the entire proposed Sale No. 48 area based upon expected resource volume.

Over the life of the lease, there is a 96 percent chance of at least one spill resulting from the proposal and affecting a high density boating area. The most likely number of spills is three. In combination with existing sources the probability rises to virtual certainty with a most likely number of spills equalling nine. These probabilities apply only to boating in the Southern California Bight as the areas north of Point Conception and south of the International Border were not digitized and, thus, not considered in the computer analysis.

[a] This is the area within the blue line on Visual No. 4.

Even a large spill will not affect the entire area identified as "high density recreational boating area". Such a spill would affect portions of the area, thus permitting boating to occur on adjacent unaffected areas.

Quantitative impacts over the life of the lease range from 21,840 to 41,340 boat-days for the Santa Barbara Channel with Santa Barbara Harbor ranging between 11,350 and 21,460 boat-days while Ventura-Oxnard Marinas range from 10,490 to 19,880 boat-days for the proposed Sale No. 48 leases. Considering all existing sources along with proposed Sale No. 48 the range is 35,250 to 66,680 boat-days for Santa Barbara and 32,600 to 61,750 for Ventura-Oxnard. In San Pedro Bay, the impact is 3,060 boat-days (Los Angeles-Long Beach Harbor), 2,440 boat-days (Alamitos-Anaheim Bay) and 4,700 boat-days (Newport) for proposed Sale No. 48. The total is 10,200 boat-days. Combined impact sources total 107,630 boat-days, broken down as follows: 32,240 boat-days (Los Angeles-Long Beach Harbor, 25,790 boat-days (Alamitos-Anaheim Bay), 49,600 boat-days (Newport). The area from Dana Point to San Diego has a low risk of spill occurrence with the risk increasing from south to north. The exposure amounts to 0.17 spill over the lease life resulting in the following: 270 boat-days (Dana Point), 150 (Oceanside), 240 (Mission Bay), 350 (San Diego Bay). For Santa Barbara Island, risk from Sale No. 48 is negligible, rising to 0.47 spills when all other sources are considered. The visitation loss could equal 3,760 visitors. If all spills occur and are spaced randomly by exposure risk throughout the area and all marinas in each subarea are affected by individual spills occurring in the subarea, then the worst case loss for the lease term would be 33,050 to 52,550 boat-days for this proposal and 180,250 to 240,830 boat-days for all sources considered together. These figures do not allow a growth factor in boating use.

The Oil Spill Model analysis process used and the way the data have been provided do not make it possible to determine confidently which tract areas or transportation legs present the greatest and least risk to the boating resource. Impact potential on central and northern California is low as it is in Baja.

Though great effort is expended to control small spills through the use of drip pans, overflow alarms and so on, they continue to occur. In most cases, the larger ones will be either boomed and recovered or dispersed with dispersants. If weather and/or sea-state precludes such containment or dispersal, then some impact may occur. Slicks begin to break up after about four days and inclement weather tends to hasten the process. The worst case would occur if the spill were to go unnoticed in relatively calm seas. Then boaters straying into the slick could suffer contamination damage. When high seas prevail, the slick would have a greater tendency to be scattered "pancakes" of oil and thus offer less of a risk of seriously oiling a boat. Loss to individuals affected could be high, though, as painting may be necessary. According to testimony given at DES hearings in San Diego, oil may penetrate a fiberglass hull to later emerge through new paint.

9. Impacts on Future Ocean Mineral Production

a. State Oil and Gas Sanctuaries: The problems arising from conflicting interests have led to various types of control. The State of California, maintaining that oil and gas development is incompatible with other uses of coastal and nearshore areas, has established oil and gas sanctuaries along portions of the mainland coast and around the offshore islands in an effort to protect State-designated sensitive regions and avoid "forced" drainage sales.

Drainage of an oil and gas pool is related to porosity and permeability, among other factors. The State of California (Everetts, 1974) maintains that as a practical matter no effective drainage can occur "over quarter of a mile". The spacing of wells to properly exploit discovered oil and gas resources is variable. Should oil and gas be discovered in those tracts sucessfully leased adjacent to State of California oil and gas santuaries, it is possible that minor drainage could occur depending upon the physical characteristics (porosity and permeability), and the location of each individually identified productive zone. Twenty-two Sale No. 48 tracts lie adjacent to State oil and gas sanctuaries: SBC 91-94, 98-108; SBI 117-119; SPB 120; and DPSD 141-143.

The impacts of discovery and development of oil and gas resources adjacent to State sanctuaries are difficult to assess quantitatively. Any close discovery and development could drain State-owned resources and force State drainage sales and development. Such drainage sales would not necessarily require surface structural development in State waters.

Section 205(g)(2) of the OCS Lands Act Amendments gives the Secretary of the Interior the authority to enter into an agreement concerning the disposition of revenues which may be generated by a Federal lease that drains State lands in order to permit fair and equitable division of such revenues between the State and Federal Governments.

b. Other Ocean Mining: Assessment of the impact of the proposed sale on future ocean mining within the Southern California OCS is dependent upon many prerequisites, the most important of which is discovery and evaluation, followed by technological advances and a supportive economic climate. As offshore oil and gas developments become more prolific, concentrated biologic, geologic, geophysical, cultural, and hazard surveys cover a larger portion of the Southern California OCS in progressively greater detail. The positive impact of this expanding network of surveys relative to oil and gas development by both Federal agencies and private industry favors the discovery and evaluation of marine (hard) mineral deposits.

Of the several minerals characteristically found on continental shelves, exploration offshore Southern California has defined the existence of areas containing phosphorite nodules, sands, and crusts, and bulk deposits of shell, sand, and gravel. Marine mining subsystems for these minerals are not yet sufficiently advanced but are one of the key requirements in developing successful mining of continental shelf hard mineral resources. Currently, emphasis is being placed on the development of techniques for the delineation and exploitation of unconsolidated marine deposits and the only available systems are shallow-water systems similar to those in use on land, in bays, or in estuaries. At the current rate of technological advance of mining systems for continental shelf minerals, several years will elapse before oil and gas development could impact other mineral development or preclude it in localized areas.

Because oil and gas production is a temporary development, lasting only as long as economic pumping may be sustained, no permanent impact will be effected by Sale No. 48 upon other ocean mining. Temporary impacts are speculative: if an oil and gas platform development is constructed upon each of the 217 tracts being assessed, approximately 98 square kilometers (37.7 square miles), or 2.1 percent of the total area proposed for leasing would be unavailable for ocean mining of hard minerals. If the percentage of tracts developed as a result of Sale No. 48 parallels the percentage of development in all previous sales, the area temporarily restricted from mineral exploitation and the consequent impacts will be significantly reduced below the nominal value above.

10. Impacts of Marine Sanctuary Designations: The NOAA Office of Marine and Estuarine Sanctuaries is in the preliminary phase of preparing a Draft Environmental Statement for each of the three areas currently under active consideration for marine sanctuary designation (see Section I.D.4). These documents are to function as the initial analytical tool in the marine sanctuary designation process and are still some months from completion.

The following is a brief discussion of possible impacts of OCS development on Marine Sanctuary designations.

Northern Channel Islands Marine Sanctuary (including Santa Barbara Island): Much of the following discussion was taken from the Santa Barbara Channel Marine Sanctuary Nomination Document prepared by the County of Santa Barbara, Department of Environmental Resources for NOAA.

The Santa Barbara Channel region is currently the focus of offshore energy development and transportation on the West Coast. Additionally, the channel's position astride the shipping routes from Alaska and the Pacific Northwest to Los Angeles and the Panama Canal subject it to extensive levels of tanker traffic and to a greater threat of oil spills, blowouts, disturbances, and chronic oil pollution than any other area of the Southern California Bight.

The effects of the present operations in the channel region have been generally local. Twelve of the fourteen active platforms in the channel are in its northeast end and none presently exist on the leased but yet undeveloped Santa Rosa plateau. Small chronic spills, increases in boat and tanker traffic, the existence of the platforms as obstructions in the water, and air emissions from tankers and platform equipment affect the channel as a whole in the short term. Outside of the mainland shelf, no development exists in or near the major foraging or habitat areas of the region. Platforms Hondo and Holly, along the west channel, have not seriously altered the west channel's environment.

The major threat to the proposed sanctuary area are oil spills. Spilled oil undergoes various transformations when it enters the marine environment, some physical, some chemical and some biological. Immediately after a spill occurs, natural forces begin to transfer oil from the surface slick into all components of marine environment - the atmosphere, water column, sediments, and inhabitants. Evaporation, wind-generated sea spray, and bubbles bursting through the slick all act to transfer oil into the atmosphere. Evaporation can disperse as much as 50 percent of the hydrocarbons over the lifetime of an "average" crude oil slick.

With the exception of seabirds, which are consistently reported to be killed in substantial numbers, the observed effects of oil spills vary widely, ranging from negligible to catastrophic. Some of the factors

influencing the extent of damage caused by any given spill are the dosage of oil, the type of oil, local weather conditions, the location of the spill, the time of year, the methods used for cleanup, and the area's previous exposure to oil.

The impact of an oil spill can be especially high in the biologically sensitive areas of the nomination area. These include regions of high productivity, i.e., the Santa Rosa plateau; habitats of organisms with critical ecological value, such as inshore channel areas during massing of market squid; reproductive areas, especially bird and pinniped rookeries such as San Miguel Island and Santa Barbara Island; feeding grounds; and migratory pathways.

The oil spill risk model predicts 3.1 spills of greater than 1,000 barrels and 6.05 spills from 50 to 1,000 barrels will occur in the Santa Barbara Channel area as a result of the proposed lease sale. The model also projects a high probability of oil spills reaching the channel coast (including the islands). The expected number of spills in the Santa Rosa Plateau area as a result of this action is 0.06. This means a total of 3.16 spills of 1,000 barrels or more are expected in the vicinity of the proposed sanctuary area. This is not to say, however, that any or all the spills would affect the sanctuary area although it is probably safe to assume that at least one would.

For a more complete discussion of the impact of OCS development within this area on seabirds, marine mammals, fish, etc., see the appropriate section in this chapter.

Areas of special biological importance to marine mammals and seabirds of the proposed sanctuary area are listed in Table III.C.10-1.

The United States Department of Commerce, National Oceanic and Atmospheric Administration has recommended that tracts SBC 098-108, 088-097 and SBI 117-119 be withdrawn from leasing to provide a development free zone, at the present time, for the protection of the natural resources of the Channel Islands. This recommendation is analyzed in the Alternative Section VIII.A.5.

Table III.C.10-1

AREAS OF SPECIAL BIOLOGICAL IMPORTANCE TO THE MARINE MAMMALS AND BIRDS OF THE SANTA BARBARA CHANNEL REGION

Zone	Area	Significance
Santa Barbara Channel	Vicinity of San Miguel Island to distance of 20 km in all directions	Largest pinniped and bird reproductive colonies in the SCB: five species of breeding pinnipeds (including northern fur seal); three species of breeding alcids and three species of breeding cormorants; young-of-the-year present in all seasons; exceptionally heavy use of near-shore waters for foraging; migratory path of gray whales (endangered); extremely high utilization as seasonal foraging area for Pacific white-sided and common dolphins. Seasonal gathering grounds of humpback whales (endangered).
	Vicinity of Santa Rosa and Santa Cruz Islands	Presence of major bird colonies, especially alcids, cormorants, and brown pelicans (endangered). Pupping grounds of harbor seals. Exceptionally heavy use of nearshore waters by foraging birds and pinnipeds.
	Vicinity of Anacapa Island and the Ventura Shelf	Second largest seabird colony in the SCB, especially brown pelican; exceptionally heavy use of these waters by foraging birds, pinnipeds and cetaceans; migratory path of gray whales and waterfowl.
	Pt. Conception to distance of 10 km seaward	Funnel for migrating birds, especially shearwaters and brant; enormous numbers of seabirds; staging area for migrating gray whales.
	Mainland shore to distance of 10 km seaward	Migration path of gray whales and water fowl.
Santa Rosa Ridge	Santa Rosa Ridge from San Nicolas Island to Santa Rosa Island	Exceptionally heavy use of shallow waters for foraging by birds, pinnipeds and cetaceans; major migratory pathway of large baleen whales along west flank. Area of greatest open water concentrations of cetacea in the SCB.

Source: Marine Mammals and Seabirds Survey, 1975-76.

Table III.C.10-2

ACREAGE AND OIL AND GAS FORGONE[a] IF OCS DEVELOPMENT WERE PROHIBITED IN A NORTHERN CHANNEL ISLANDS MARINE SANCTUARY DESIGNATION

Scenario 1 - Sanctuary around the islands with a boundary 6 miles seaward.

Sale No. 48 Lease Area	Acreage Forgone	Oil (mmbl) Forgone	Gas (Billion Cu. Ft.) Forgone
Santa Barbara Channel	129,102 acres (52,246 ha)	71.0	71.0
Santa Rosa	5,760 acres (2,331 ha)	2.5	0.4
Santa Barbara Island	18,220 acres (7,374 ha)	8.0	6.4
Combined Total	153,082 acres (61,951 ha)	81.5	77.8

Scenario 2 - Sanctuary around the islands with a boundary 12 miles seaward.

Sale No. 48 Lease Area	Acreage Forgone	Oil (mmbl) Forgone	Gas (Billion Cu. Ft.) Forgone
Santa Barbara Channel	336,462 acres (136,162 ha)	185.4	185.4
Santa Rosa	23,040 acres (9,324 ha)	7.5	1.2
Santa Barbara Island	23,980 acres (11,655 ha)	10.0	8.0
Combined Total	383,482 acres (151,141 ha)	202.9	194.6

[a]The basic assumption was that if any portion of a tract fell within a proposed sanctuary boundary the entire tract would be deleted.

Table III.C.10-2 lists acreage, million BBL of oil and billion cubic feet of gas estimated to be foregone from the proposed lease sale as a result of a Channel Islands marine sanctuary being designated. The worst case, from the marine sanctuary point of view, could be that proposed Sale No. 48 could eliminate the establishment of marine sanctuaries in the area if the sanctuary objectives called for no joint use of the nominated areas.

Farallon Islands - Point Reyes Marine Sanctuary. No direct impacts are expected upon this area due to the proposed action because of their considerable distance from possible lease tracts. However, U.S. Coast Guard designated shipping lanes do run through the proposed sanctuary area. This may result in secondary impacts due to tanker spills of oil originating from the proposed lease sale. Probably the best mitigating measure, in this case, would be to remove the shipping lanes from within the sanctuary area, although this will not be expected to completely alleviate the impacts since shipping will likely remain near the sanctuary area.

A Farallon Island - Point Reyes marine sanctuary will not impact OCS development within the Sale No. 48 area.

Monterey - Big Sur Marine Sanctuary. No direct impacts are expected. However, designated shipping lanes do run through the proposed sanctuary area. Tanker spills of oil originating from the proposed lease tracts and being shipped to San Francisco are possible.

Removal of these shipping lanes from the sanctuary area would mitigate these impacts somewhat, although the threat may still exist if the lanes were nearby.

A Monterey - Point Sur Marine Sanctuary would not impact OCS development in the proposed Lease Sale No. 48 area.

The United States Department of Commerce, National Oceanic and Atmospheric Administration has recommended that tracts SBC 098-108, 088-097 and SBI 117-119 be withdrawn from leasing to provide a development free zone, at the present time, for the protection of the natural resources of the Channel Islands. This recommendation is analyzed in the Alternative Section VIII.A.13.

Conclusions. At the present time, there are only recommendations for marine sanctuaries within the area covered by this statement. Until specific areas are nominated, any discussion of impacts either upon the sanctuary area or upon OCS development as a result of formal designation is academic. The actual area of the marine sanctuary must be identified along with the purpose before a meaningful analysis of impacts can be discussed.

D. Impacts of the Proposal on Air Quality

1. Air Emissions from OCS Oil and Gas Development and Other Proposed Projects

a. OCS Operations: The oil and gas developments in the Southern California Bight were defined in terms of barrels of oil per day (bbl/d) or billions of cubic feet of gas (Bcf) per day in each of the following production areas:

Santa Barbara Channel	Tanner/Cortez Banks
Santa Rosa Island	San Pedro
Santa Barbara Island	Dana Point - San Diego

The peak production year of 1986 (Sale No. 48) was used in the modeling to determine the maximum impact. Other years will have less production and thus have less impact. No specific descriptions are available for the equipment that would be located offshore and onshore since this will be determined primarily by the lease holders. Nor is any information available on the exact locations of the offshore platforms because this will depend on the tracts leased and, ultimately, on the extent and location of the oil reservoirs or structures which are unknown at this time.

Air emissions associated with OCS development were, therefore, estimated by general techniques which involve assuming that operations can be divided into a number of categories as shown below:

Oil production	Marine loading
Gas production	Marine transport
Oil processing	Storage
Gas processing	

Factors have been developed for each of these categories (or subcategories) that can be used to estimate air emissions of hydrocarbons, nitrogen oxides, carbon monoxides, sulfur oxides and particulates based on the throughput of oil and gas.

The modeling studies require that emissions be distributed in space by assigning them to the appropriate location in a network of grid squares. Each of the production areas in the previous list above encompassed several grid squares so the emissions were apportioned evenly to several discrete locations within each production area. The crude oil and gas from the Santa Barbara Channel has a slightly different chemical composition than that from the other production areas, so different emission factors were used for this area when appropriate. This method of approach predicts that most platforms within a given area will have identical emissions that depend on the total oil and gas from the

specified production area, and that Santa Barbara Channel platforms will have slightly different emissions because of the different crude oil in that area.

The rationale for the choice of emission factors, assumptions regarding the production scenarios, and methodology for calculating emissions is explained and tabulated in Air Quality Analysis of the Southern California Bight in Relation to Potential Impact of Offshore Oil and Gas Development: Final Report (AeroVironment, 1977). All emission factors used were taken from published sources and modified as necessary on the basis of consultation with experts from agencies and industry. No original field tests were performed to improve the existing data base. Emissions from OCS developments including non-Sale No. 48 activities for each tankering scenario were calculated in kg/hr for each pollutant for 1986. These emissions calculations are presented in the AeroVironment Report (1977).

Table III.D.1.a-1 presents emissions of various air pollutants from Sale No. 48-related sources by county area. Emissions from platforms located near Santa Rosa Island, Santa Barbara Island and Tanner/Cortes Banks were listed under "others". These emissions are the sums of maximum emission rates from all sources even though, in reality, not all sources would be operational simultaneously. Also shown, are estimated annual emissions in tons per year.

Emission rates from each area were compared with currently available inventory data for that specific county area. The total Sale No. 48 emission rates are compared to the emission rates as estimated for the South Coast Air Basin.

Secondary Emissions. As discussed later in Section III.E.14, population increases associated with Sale No. 48 activities are estimated to range from 0.01 percent in Orange County to 3.01 percent in Ventura County for the year 1986. Accompanying these population increases will be increases in emissions from non-industrial activities such as auto travel, household heating, waste disposal, and household solvent use. These were not computed explicitly but were taken into account for the modeling runs by making adjustments in the area source inventories obtained from the sources referenced. For the photochemical modeling runs, the hydrocarbons from area sources were assumed to remain constant from 1975 to 1986. This assumes that the decrease in hydrocarbons resulting from the application of exhaust controls is balanced by an equivalent increase in secondary emissions. This technique makes too large an allowance for secondary emissions, even in Ventura County, but it was done deliberately to guarantee that a worst case condition was modeled.

Table III.D.1.a-1

EMISSIONS FROM SALE NO. 48 (NORMAL TANKERING)

Kg/hr
(Tons/yr)

Area	THC	NO_x	CO	SO_2	TSP
Santa Barbara					
Onshore	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Offshore tankering loading	539.1 (360.1)	9.2 (6.1)	0.36 (0.24)	76.0 (50.8)	4.4 (2.9)
All other emissions	139.6 (17.75)	32.0 (309.1)	0.56 (541)	22 (212)	23 (222)
% of Coastal SB Inventory, 1975	114 (31)	48 (4.6)	1.4 (1.4)	222 (6.2)	21 (18)
Ventura					
Onshore	0	0	0	0	0
Barge loading[a]	(1715)	(172)	(0.1)	(0.3)	(0.1)
Oil and gas processing	824 (7958)	754 (7282)	0 (0)	46 (444)	0.8 (7.7)
Offshore	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
% of Ventura Inventory, 1975	24 (30)	22 (23)	0 (<0.1)	2.4 (2.3)	<0.1 (<0.1)
Los Angeles/Orange					
Onshore Barge loading	0.9 (0.8)	11.6 (10.0)	2.5 (2.2)	0.8 (0.7)	0.9 (0.8)
All other emissions	86 (831)	75 (724)	0 (0)	4.0 (39)	0 (0)
Offshore	13.2 (127)	79.8 (771)	18.9 (183)	6.6 (64)	7.2 (70)
% of County Inventories, 1975	<0.2 (<0.2)	0.4 (0.3)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)

San Diego/ Dana Point					
Onshore	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Offshore	167	6.6	0.02	0.06	0.03
Barge loading	(110)	(11)	(0)	(0)	(0)
All other emissions	55 (531)	105 (1014)	13.9 (134)	6.6 (64)	4.8 (46)
% of San Diego Inventory, 1975	1.7 (0.5)	1.6 (1.5)	<0.1 (<0.1)	0.4 (0.4)	<0.1 (<0.1)
Others[b]					
Onshore	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Offshore Barge loading	170 (42)	2.5 (0.6)	0.02 (0)	0.06 (0.02)	0.03 (0)
All other emissions	54 (522)	362 (3496)	72 (695)	25.8 (249)	28 (270)
GRAND TOTAL	2043	1726	163	188	69
	(13,972)	(16,578)	(1556)	(1124)	(620)

[a] Barge loading from Sale No. 48 increases the frequency of occurrence of maximum hourly emissions but does not change the magnitude of maximum emission flux.

[b] Platforms near Santa Rosa Island, Santa Barbara Island and Tanner/ Cortes Banks. Platforms in the Santa Barbara Channel are included with Santa Barbara area emissions.

In Table III.D.1.a-1, the increase in hydrocarbon emissions for the 100-percent tankering scenario occurs because of the vapor losses during tanker loading and transportation processes. The decrease in nitrogen and sulfur oxides emissions for the same scenario is due to the elimination of gas processing activities since gas recovered would be reinjected into the oil field. For the normal tankering scenario, a small amount of H_2S would also be emitted during the handling of natural gas produced in the Santa Barbara Channel.

Oil and Gas Offshore Production. Offshore emissions from platforms and single buoy moors (SBM) are estimated for OCS and tideland activities for both tankering scenarios. These emission rates include the emissions associated with offshore marine loading, transport and storage. The assumed locations for OCS platforms and SBM's are given in Table III.D.1.a-2. Estimated emission rates from offshore platforms for normal tankering in 1986 are presented in Table III.D.1.a-3 and for 100-percent tankering in 1986 in Table III.D.1.a-4.

Estimated rates for SBM's for 1986 are presented in Table III.D.1.a-5 for normal tankering and in Table III.D.1.a-6 for 100-percent tankering.

Oil and Gas Onshore Processing. Emission rates associated with onshore oil and gas processing are estimated. These emissions rates include the emissions associated with onshore loading, unloading and storage. The emission rates from all onshore oil and gas processing for 1986 are presented in Table III.D.1.a-7 for normal tankering and in Table III.D.1.a-8 for 100-percent tankering.

b. Accidents: In this study, possible offshore accidents are also investigated. It must be noted that the statistical probability of an actual spill or blowout of these magnitudes are quite low, and these assumptions should not be construed as expectations. These accidents include well blowout with and without fire, and small (140 barrels) and large (10,000 barrels) oil spills at four potential accident sites. Estimated emissions from these accidents are listed in Table III.D.1.b-1. They are significant when compared to emissions from routine operations, especially in the case of the 10,000 barrel oil spill. During such an accident, depending on the composition of the crude oil, 150,000 to 260,000 kg of total hydrocarbons would escape into the atmosphere in the first hour and 75,000 to 130,000 kg would escape in the second hour. Vapor loss in the first hour is more than four times the amount of hydrocarbons emitted in the entire South Coast Air Basin in 1 hour and, therefore, has significant air quality impacts. It should also be noted that the possibility of 10,000 barrels of oil being released instantaneously is very remote. It is much more probable that a spill of this magnitude would take place over many hours (several days or weeks).

Table III.D.1.a-2

ASSUMED LOCATIONS FOR OCS PLATFORMS AND SBMs

LOCATIONS	Sale 35 UTM E	Sale 35 UTM N	Sale 48 UTM E	Sale 48 UTM N
SANTA BARBARA CHANNEL PLATFORMS				
Hueneme	288	3776		
Santa Clara (North)	278	3784		
Santa Clara (South)	279	3778		
Santa Ynez (Hondo)	208*	3804*		
Santa Ynez (Secata Pescado)	192*	3806*		
Platform No. 1			162*	3809*
Platform No. 2			184*	3794*
Platform No. 3			213*	3782*
Platform No. 4			219*	3795*
Platform No. 5			258	3796
Platform No. 6			270	3777
Platform No. 7			272	3792
SANTA ROSA ISLAND PLATFORMS				
Platform No. 1	224	3748	219*	3739*
Platform No. 2	235	3733		
SANTA BARBARA ISLAND PLATFORMS				
Platform No. 1	298	3714	308	3722
Platform No. 2	298	3710		
Platform No. 3	298	3705		
TANNER/CORTEZ PLATFORMS				
Platform No. 1	273	3644	263	3652
Platform No. 2	276	3643	279	3640
Platform No. 3	278	3644	289	3643
Platform No. 4	284	3643	278	3623
Platform No. 6	276	3640	293	3621
Platform No. 6	284	3639	309	3620
Platform No. 7	288	3639	285	3612
Platform No. 8	276	3635	322	3612
Platform No. 9	284	3635	300	3600
Platform No. 10	288	3635		
Platform No. 11	290	3629		
Platform No. 12	295	3630		
Platform No. 13	292	3627		
Platform No. 14	288	3626		
Platform No. 15	295	3626		
Platform No. 16	302	3625		
Platform No. 17	298	3621		
Platform No. 18	284	3621		
Platform No. 19	294	3616		
Platform No. 20	294	3612		
Platform No. 21	298	3612		
Platform No. 22	302	3612		
Platform No. 23	302	3616		
Platform No. 24	316	3616		
Platform No. 25	288	3606		
SAN PEDRO PLATFORMS				
Platform No. 1	394	3723	384	3715
Platform No. 2	391	3719	394	3705
Platform No. 3	404	3715	411	3707
Platform No. 4	394	3714		
Platform No. 5	398	3710		
Platform No. 6	389	3709		
Platform No. 7	404	3704		
Platform No. 8	405	3699		
SAN DIEGO/DANA POINT PLATFORMS				
Platform No. 1			432	3694
Platform No. 2			443	3681
Platform No. 3			455	3623
SANTA BARBARA CHANNEL SBMs				
SBM No. 1	185*	3791*	163*	3808*
SBM No. 2	209*	3803*	221*	3795*
SBM No. 3	259	3789		
SANTA ROSA ISLAND SBM	237	3733	219*	3738*
SANTA BARBARA ISLAND SBM	298	3710	308	3721
TANNER/CORTEZ SBMs				
SBM No. 1	274	3643	302	3599
SBM No. 2	291	3629		
SBM No. 3	316	3617		
SAN PEDRO SBM	396	3715	401	3705
SAN DIEGO/DANA POINT SBM			456	3623

* Extended UTM Zone 11

Note: UTM - Universal Transverse Mercator

Table III.D.1.a-3

EMISSION RATES FROM OFFSHORE PLATFORMS, 1986. NORMAL TANKERING

LOCATION	UTM E	UTM N	EMISSIONS, kg/hr per platform: THC Fugitive	THC Diesels	NO_x Gas Turbines	NO_x Diesels	CO Diesels	SO_2 Diesels	TSP Diesels
NON OCS - TIDELINES									
South Elwood	232	3808	0.7	2.0	8.4	3.0	2.4	1.1	1.1
Summerland	263	3808	0.1	0.2	2.2	0.3	0.2	0.1	0.1
Carpentaria	268	3805	0.1	0.4	0.9	0.5	0.4	0.2	0.2
Other (1)	187	3812	0	0.1	1.75	0.1	0.1	0.05	0.05
Other (2)	192	3815	0	0.1	1.75	0.1	0.1	0.05	0.05
OCS ACTIVITIES - NON SALE 48									
Carpentaria (Henry)	266	3803	0.2	0.5	1.4	0.8	0.6	0.3	0.7
Heuneme	288	3776	0.3	0.8	0	1.2	0.97	0.45	0.45
Dos Cuadras	260	3803	0.7	1.9	1.9	2.9	2.3	1.05	1.05
Santa Clara (N)	278	3784	2.2	6.5	26.7	9.4	7.4	3.5	3.5
Santa Clara (S)	279	3778	2.7	7.9	42.9	11.4	9.0	4.2	4.2
Santa Ynez (Hondo)	208	3804	9.0	26.8	81.1	38.9	30.7	14.3	14.3
Santa Ynez (Secata Pescado)	192	3806	4.2	12.2	35.9	18.1	13.6	6.3	6.3
Santa Rosa Island (#1 and #2)	a	a	0.1	0.3	1.6	0.4	0.35	0.15	0.15
Santa Barbara Island (#1, 2 and 3)	a	a	0.11	0.32	0.9	0.4	0.37	0.17	0.17
Tanner/Cortez (#1 through 25)	a	a	0.57	1.71	8.7	2.4	1.95	0.91	0.91
San Pedro (#1 through 8)	a	a	0.47	1.40	3.8	2.0	1.6	0.75	0.75
OCS ACTIVITIES - SALE 48									
Santa Barbara Channel (#1 through 7)	b	b	1.6	4.8	12.6	22.3	7.9	3.0	3.2
Santa Rosa Island (#1)	b	b	0.8	2.5	6.7	19.0	5.3	1.8	2.0
Santa Barbara Island (#1)	b	b	0.6	1.9	1.9	18.2	4.7	1.5	1.7
Tanner/Cortez (#1 through 9)	b	b	1.3	3.8	13.9	21.0	6.9	2.5	2.7
San Pedro (#1 through 3)	b	b	1.1	3.3	6.4	20.2	6.3	2.2	2.4
San Diego/Dana Point (#1 through 3)	b	b	3.9	11.7	14.9	18.1	4.6	2.2	1.6

[a] See Table III.D.1.a-2 for location of each platform
[b] See Table III.D.1.a-7 for location of each platform

Note: UTM - Universal Transverse Mercator
NO_x - Nitrogen oxides
CO - Carbon monixide
SO_2 - Sulfur dioxide
TSP - Total suspended particles

Table III.D.1.a-4

EMISSION RATES FROM NON-48 SALE PLATFORMS -- 1986, 100% TANKERING

LOCATION	UTM		Emissions, Kg/hr per platform						
			THC		NO_x		CO	SO_2	TSP
	E	N	Fugitive	Diesels	Gas Turbines	Diesels	Diesels	Diesels	Diesels
Non OCS - Tidelands									
South Elwood	232	3808	0.7	2.0	8.4	3.0	2.4	1.1	1.1
Summerland	263	3808	0.1	0.2	2.2	0.3	0.2	0.1	0.1
Carpenteria	268	3805	0.1	0.4	0.9	0.5	0.4	0.2	0.2
Other (1)	187	3812	0.03	0.07	1.75	0.1	0.1	0.05	0.05
Other (2)	192	3815	0.03	0.07	1.75	0.1	0.1	0.05	0.05
Belmont Offshore	420	3723	0.15	0.45	0.4	0.6	0.5	0.2	0.2
Huntington Beach	396	3731	1.7	5.1	2.6	7.4	5.8	2.7	2.7
Wilmington	392	3735	3.0	9.1	5.8	13.1	10.4	4.8	4.8
Other	368	3745	0.05	0.15	0.6	0.2	0.2	0.1	0.1
OCS Activities - Non Sale 48									
Carpenteria (Henry)	266	3803	0.2	0.5	-0-	0.8	0.6	0.3	0.3
Hueneme	288	3776	0.3	0.8	-0-	1.2	1.0	0.45	0.45
Dos Cuadras	260	3803	0.7	1.9	-0-	6.3	5.0	2.3	2.3
Santa Clara (N)	278	3784	2.2	6.5	-0-	9.4	7.4	3.5	3.5
Santa Clara (S)	279	3778	2.7	7.9	-0-	11.4	9.0	4.2	4.2
Santa Ynez (Hondo)	208	3804	9.1	26.7	-0-	38.9	30.7	14.3	14.3
Santa Ynez (Secata Pescado)	192	3806	4.2	12.4	-0-	17.2	13.6	6.3	6.3
Santa Rosa Island (#1 and 2)	*	*	0.1	0.3	-0-	0.45	0.35	0.15	0.15
Santa Barbara Island (#1, 2,& 3)	*	*	0.11	0.3	-0-	0.47	0.37	0.17	0.17
Tanner/Cortez (#1 thru 25)	*	*	0.6	1.7	-0-	2.5	2.0	0.9	0.9
San Pedro (#1 thru 8)	*	*	0.48	1.4	-0-	2.0	1.6	0.8	0.8
OCS Activities - Sale 48									
Santa Barbara Channel (#1 thru 7)	*	*	1.3	5.1	-0-	22.4	7.9	3.0	3.2
Santa Rosa Island (# 1)	219	3739	0.5	2.8	-0-	19.0	5.3	1.8	2.0
Santa Barbara Island (# 1)	308	3722	0.3	2.2	-0-	18.2	4.7	1.5	1.7
Tanner/Cortez (#1 thru 9)	*	*	1.0	4.1	-0-	21.0	6.9	2.5	2.7
San Pedro (#1,2, and 3)	*	*	0.8	3.6	-0-	20.2	6.3	2.2	2.4
San Diego / Dana Pt (#1 thru 3)	*	*	0.3	2.1	-0-	18.1	4.6	1.4	1.6

*. See Table III.D.1.a-2 for locations of individual platforms

Table III.D.1.a-5

EMISSION RATES FROM SBMs, 1986. NORMAL TANKERING

LOCATION	UTM E	UTM N	Activity	EMISSIONS, Kg/hr per SBM: THC Fugitive	THC Ships*	NO_x Process Stocks	NO_x Ships*	CO Ships*	SO_2 Ships*	TSP Ships*
OCS ACTIVITIES, NON SALE 48										
Santa Barbara Channel (#2, 3)	See table A-5 for location of each SBM		Storage	96.3	0	40.9	0	0	0	0
			Tanker loading	630	0.6	40.9	9.2	0.36	76.0	4.4
Santa Barbara Island	298	3710	Storage	4.1	0	2.8	0	0	0	0
	298	3710	Barge loading	173	0.2	2.8	0.1	0.02	0.06	0.08
OCS ACTIVITIES, SALE 48 Santa Barbara Channel	221	3795	Storage	88.9	0	37.6	0	0	0	0
	221	3795	Tanker loading	538.5	0.6	37.6	9.2	0.36	76.0	4.4
Santa Barbara Island	308	3721	Storage	3.1	0	2.45	0	0	0	0
	308	3721	Barge loading	169.5	0.02	2.45	0.05	0.02	0.06	0.03
San Diego/Dana Point	456	3623	Storage	8.32	0	6.54	0	0	0	0
	456	3623	Barge loading	166.5	0.02	6.54	0.06	0.02	0.06	0.03

[a]See Table III.D.1.a-2 for location of each SBM
*From tanker stacks during tanker loading and tug stacks during barge loading
Note: See Table III.D.1.a-3

Table III.D.1.a-6

EMISSION RATES FROM SBMs, 1986. 100% TANKERING

Location	UTM E	UTM N	Activity	Emissions, Kg/hr per SBM: THC Fugitive	THC Ships*	NO_x Process Stocks	NO_x Ships*	CO Ships*	SO_2 Ships*	TSP Ships*
OCS Activities, Non Sale 48										
Santa Barbara Channel (#1, 2 and 3)	**	**	Storage	126.3	0	54.4	0	0	0	0
	**	**	Tanker loading	635.	0.6	54.4	9.2	0.36	76.0	4.4
	**	***	Barge loading	1,397.	0.01	54.4	0.1	0.02	0.13	0.07
Santa Rosa Island	219	3738	Storage	3.9	0	1.8	0	0	0	0
	219	3738	Barge loading***	515.	0.01	1.8	0.1	0.02	0.13	0.07
Santa Barbara Island	298	3710	Storage	3.6	0	2.8	0	0	0	0
	298	3710	Barge loading***	172.	0.01	2.8	0.05	0.01	0.06	0.03
Tanner/Cortez (#1, 2 and 3)	**	**	Storage	84.6	0	41.1	0	0	0	0
	**	**	Tanker loading	248.	0.6	41.1	9.2	0.36	76.0	4.4
	**	**	Barge loading	533	0.01	41.1	0.1	0.02	0.13	0.07
San Pedro	396	3715	Storage	40.2	0	32.4	0	0	0	0
	396	3715	Barge loading	554.	0.01	32.4	0.1	0.02	0.13	0.07
OCS Activities, Non Sale 48 and Sale 48										
Santa Barbara Channel (all 5)	**	**	Storage	110.1	0	47.7	0	0	0	0
	**	**	Tanker loading	632	0.6	47.7	9.2	0.36	76.0	4.4
	**	**	Barge loading	1,394.	0.01	47.7	0.1	0.02	0.13	0.07
Santa Rosa Island	219	3738	Storage	7.7	0	5.9	0	0	0	0
	219	3738	Barge loading***	522.	0.01	5.9	0.1	0.02	0.13	0.07
Santa Barbara Island	298	3710	Storage	6.7	0	5.2	0	0	0	0
	298	3710	Barge loading***	178	0.01	5.2	0.1	0.02	0.13	0.07
Tanner/Cortez (all 4)	**	**	Storage	60.4	0	48.8	0	0	0	0
	**	**	Tanker loading	289	0.6	48.8	9.2	0.36	76.0	4.4
	**	**	Barge loading	574.	0.01	48.8	0.1	0.02	0.13	0.07
San Pedro (#1 Sale 35)	396	3715	Storage	40.2	0	32.4	0	0	0	0
	396	3715	Barge loading	554.	0.01	32.4	0.1	0.02	0.13	0.07
San Pedro (#1 Sale 48)	401	3705	Storage	25.0	0	19.6	0	0	0	0
	401	3705	Barge loading	539	0.01	19.6	0.1	0.02	0.13	0.07
San Diego / Dana Point	456	3623	Storage	8.3	0	6.5	0	0	0	0
	456	3623	Barge loading	179.3	0.01	6.5	0.05	0.01	0.06	0.03

* From Tanker stacks during tanker loading and tug stacks during barge loading

** See Table III.D.1.a-2 for locations of individual SBMs

*** Barges not loaded simultaneously at Santa Rosa and Santa Barbara Islands

Note: See Table III.D.1.a-2

Table III.D.1.a-7

EMISSION RATES FROM ONSHORE OIL AND GAS PRODUCTION ACTIVITIES, 1986. NORMAL TANKERING

Production Activity	UTM		EMISSIONS, Kg/hr							
			THC	NO_x		CO	SO_2		TSP	H_2S
	E	N	Fugitive	Process Stacks	Gas Turbines		Process Stacks	Flare Stacks		Fugitive
NON OCS - TIDELANDS										
South Elwood	235	3812	32.3	6.0	24.4	0	0.1	1.75	0	0.80
Summerland	267	3808	7.9	0.6	6.3	0	0	0.46	0	0.21
Carpenteria/Dos Cuadras	277	3804	19.3	18.1	2.8	0	0.70	0.20	0	0.09
Other (1)	182	3818	0.12	0.23	0	0	0	0	0	0
Other (2)	204	3818	12.4	0.3	10.2	0	0	0.73	0	0
Belmont-gas	391	3745	1.3	0	1.1	0	0	0.1	0	0
Belmont-oil	397	3735	0.7	1.3	0	0	0	0	0	0
Huntington Beach	409	3723	16.8	14.8	7.5	0	0	0.5	0	0
Wilmington	388	3736	36.3	26.6	18.6	0	0	1.3	0	0
OCS ACTIVITIES, NON SALE 48										
Ventura-gas	286	3796	1412	0	1180	0	0	85.2	0	0.02
Ventura-oil	287	3795	1052	199.4	0	0	0	0	0	0
Ventura-loading Dos Cuadras	287	3795	1477	199.5	0	0	0	0.1*	0.1*	0
Ventura-loading Wilmington	287	3795	620	199.5	0	0	0	0.1*	0.1*	0
Ventura-loading both crudes	287	3795	1992	199.6	0	0.1*	0	0.3*	0.1*	0
Wilmington-gas	388	3736	105.5	0	88.2	0	0	6.4	0	0
San Pedro-unloading 1 barge	388	3736	.4-.9**	.05-.10*	4.3-11.5**	0.9-2.6**	.25-.69**	.06-.13*	.33-.89	0
San Pedro-storage	388	3736	16.2	0	0	0	0	0	0	0
OCS ACTIVITIES, SALE 48										
Ventura-gas	286	3796	763	0	638	0	0	46	0	0.84
Ventura-oil	287	3795	61.3	116.2	0	0	0	0	0	0
Ventura-loading	287	3795	Same as for non Sale 48. Frequency increases but not max. rate							
Wilmington-oil and gas	388	3736	76.8	55.4	19.6	0	2.6	1.4	0	0
San Pedro-unloading 1 barge	388	3736	.4-.9**	.05-.10*	4.3-11.5**	0.9-2.5**	.25-.69**	.06-.13*	.33-.89	0
San Pedro-storage	388	3736	9.1	0	0	0	0	0	0	0

*Tug stacks
**Barge pumps
Note: See Table III.D.1.a-3

Table III.D.1.a-8

EMISSION RATES FROM ONSHORE OIL AND GAS PRODUCTION ACTIVITIES, 1986. 100% TANKERING

Production Activity	UTM		Emissions Kg/hr							
			THC	NO_x		CO	SO_2		TSP	H_2S
	E	N	Fugitive	Gas Turbines	Process Stocks		Gas Turbines	Flare Stocks		
Non OCS - Tidelands										
South Elwood	235	3812	32.3	24.4	6.0	0	0.01	0.73	0	0.33
Summerland	267	3808	7.9	6.3	0.3	0	0	0.46	0	0.21
Carpinteria / Dos Cuadras	277	3804	19.3	2.8	16.5	0	0.70	0.20	0	0.09
Other (1)	182	3818	0.12	0	0.23	0	0	0	0	
Other (2)	204	3818	12.4	10.2	0.3	0	0.01	0.73	0	0.00
Belmont (gas)	391	3745	1.3	1.1	0	0	0	0.1	0	0.00
Belmont (oil)	397	3735	0.7	0	1.7	0	0	0	0	
Los Angeles & Tidelands + Non Sale 48 OCS										
Huntington Beach - loading and processing	409	3723	16.8	7.5	14.8	0	0	0.5	0	0.00
Wilmington - loading and processing	388	3736	141.8	106.8	26.6	0	0	7.7	0	0.00
San Pedro - storage only	388	3736	16.2	0	0	0	0	0	0	0
San Pedro - unloading 3 large and 1 small barges	388	3736	14.5+ 3.1**	38.8**	0.4*	8.4**	2.3**	0.5*	3.0	0
Los Angeles Tidelands + All OCS Sales										
Huntington Beach	409	3723	16.8	7.5	14.8	0	0	0.5	0	0
Wilmington	388	3736	141.8	106.8	26.6	0	0	7.7	0	0
San Pedro - storage only	388	3736	25.3	0	0	0	0	0	0	0
San Pedro - unloading 3 large and 2 small barges	388	3736	22.7+ 3.5**	43.2**	0.4*	9.3**	2.6**	0.5*	3.3	0

* Tug stacks
** Barge pumps

Note: See Table III.D.1.a-3

Table III.D.1.b-1

EMISSION RATES FROM OIL SPILLS AND BLOWOUTS (Kg/hr)

AREA	UTM Coordinates		140 Barrel Spill		10,000 Barrel Spill		1000 b/d Blowout No Fire		1000 Barrel/day blowout + fire				
	East	North	1st hr. THC	2nd hr. THC	1st hr. THC	2nd hr. THC	THC	H_2S	THC	NO_x	CO	SO_2	TSP
Santa Barbara Channel	208*	3803*	3600	1800	260,000	130,000	3600	15	300	20	300	180	60
Tanner/Cortez Banks	291	3629	2100	1050	150,000	75,000	2100	.01	300	20	300	180	60
San Pedro	396	3715	2100	1050	150,000	75,000	2100	.01	300	20	300	180	60
San Diego/Dana Point	457	3623	2100	1050	150,000	75,000	2100	.01	300	20	300	180	60

*Extended UTM Zone 11

Note: THC - Total hydrocarbon, methane included

c. Emissions From Other Major Proposed Projects: One of the objectives of the overall study is to model the impact of Sale No. 48 in a scenario that includes other major proposed projects as well as those related to OCS developments. It is thus necessary to estimate the emissions from these other projects - LNG terminal, including the two separate potential locations of this focality at Point Conception and Oxnard, SOHIO project, space shuttle, Elk HIlls pipeline terminal, and Vaca Tar Sands thermal oil recovery - to provide input to the modeling effort. To the extent possible, emissions have been taken directly from EIS's and related documents. Calculations are limited to changing the units in which the emissions were expressed and supplying routine calculations to correct obvious omissions in published reports. The one exception was the Vaca Tar Sands project which is in the preliminary planning stages and has no EIS that describes the project. A detailed calculation was done for this facility. The locations of these projects are shown in Table III.D.1.c-1.

These other major projects are all located onshore and thus will undergo New Source review (NSR). The NSR process will insure that these projects are consistent with all applicable air quality laws, regulations and plans. Thus, any air quality exceedances identified from these projects should only be interpreted as the potential for conflict between Sale No. 48 and these other major projects.

Table III.D.1.c-1

LOCATIONS FOR OTHER PROPOSED PROJECTS

Proposed Project	UTM E	UTM N
SOHIO-Port Location	388	3,734
Elk Hills Terminal	295	3,781
LNG Unloading-Oxnard	294	3,784
LNG Unloading-Pt. Conception	182	3,817
Vaca Tar Sands	304	3,786
Space Shuttle	172	3,847

LNG Terminals: Emissions estimates for the trim heaters and vaporizers for use at Point Conception and Oxnard, and the seawater heater at the Oxnard location were obtained from Reference Documents (UCLA, 1976; Dames and Moore, 1974a, Volume III). The estimated emission rates from LNG terminals are given in Table III.D.1.c-2. These values compare favorably with estimates made by the Ventura County Air Pollution District (1977).

Although the California PUC has recommended the Point Conception location and the Oxnard alternative is extremely unlikely, both alternatives are included in the analysis.

Table III.D.1.c-2

ESTIMATED LNG EMISSIONS
(LNG TERMINAL EMISSIONS (UNLOADING FACILITY) AT PEAK OPERATION)

Operation	NO_2 (kg/hr)	SO_2 (kg/hr)	HC (kg/hr)
Oxnard			
Storage Tanks	-	-	1.13
Trim Heaters	10.4	0.31	-
Vaporizers	45.36	1.8	-
Seawater Heater	31.7 (corrected)	1.17	-
TOTAL	87.46	3.28	1.13
Point Conception			
Storage Tanks	-	-	1.13
Trim Heaters	27.18	0.9	-
Peaking Vaporizers	45.36	1.8	-
TOTAL	72.54	2.7	1.13

Hydrocarbon emissions from storage tanks were estimated by applying emission equations from Compilation of Air Pollutant Emission Factors, Second Edition, EPA Document AP-42 to tanks described in the Dames and Moore EIR's (1974a, Volumes II and III).

SOHIO Project. Emissions for the SOHIO project were obtained from two sources for 700,000 bbl/day delivery of crude oil. The EIR (Long Beach, 1977) gives average emissions at the port and a CARB (1977) report gave total emissions occurring south of Point Conception. These values are given in kg/hour in Table III.D.1.c-3.

Space Shuttle. Each launching of a space shuttle will involve the ignition of a solid propellant rocket booster (SRB) as well as the orbiter main engines. In a normal launch, a "ground cloud" of exhaust products is formed at the base of the launch platform. This cloud includes hot exhaust products from the SRB's, the main liquid propulsion engines, steam from launch platform cooling and acoustic damping water injection, and some sand and dust drawn into the cloud from the platform area. Because of the high temperature of the gas cloud, buoyancy effects cause it to rise to an altitude of 0.7 to 3 km (0.4 to 1.8 miles) where it stabilizes because of the cooling of the gases.

Combustion products are released into various layers of the atmosphere as the vehicle gains altitude during launch. Table III.D.1.c-4 shows the amounts of combustion products (NASA, 1977) released to the surface

Table III.D.1.c-3

ESTIMATED SOHIO PROJECT EMISSIONS (700,000 BBL/DAY DELIVERY)

	THC	SO_2	NO_x	CO	TSP
At Terminal[a]					
Storage Tank	38.2	0	0	0	0
Fugitive	1.3	0	0.15	0.92	0
Tanker Exhaust	0.83	21.5	11.3	0.16	1.96
Tanker Fueling	0.04	0	0	0	0
Tugboat	0.07	0.21	3.1	0.46	0.14
Electricity Generation	0.88	23.5	11.2	Neg.	2.3
TOTAL	41	45	26	1.5	4.4
Total Emissions South of Point Conception[b] (most probable case)	1,525	420	147	Not Given	21

[a]Long Beach, 1977.
[b]CARB, 1977.

Table III.D.1.c-4

EXHAUST PRODUCTS EMITTED PER LAUNCH BY THE SPACE SHUTTLE VEHICLE INTO THE SURFACE BOUNDARY LAYER (NASA, 1977)

Exhaust	Quantity (kg)
Hydrogen Chloride	20,324
Chlorine	2,312
Nitric Oxide	1,446
Carbon Monoxide	75
Carbon Dioxide	44,216
Water	70,138
Particulate (aluminum oxide)	32,334

boundary layer (0 to 500 m; 500 meters = 46.81 yards). These estimates take into account the ground cloud effect and afterburning within the rocket plume which converts large quantities of emitted CO to CO_2.

Elk Hills Pipeline Terminal. It is to be assumed that 250,000 bbl/d of oil will be pipelined to Port Hueneme, and oil will be loaded into tankers for subsequent transport to Los Angeles or San Francisco. Data presented in the Elk Hills EIS (URS Company, 1977) were used to estimate the emissions in Table III.D.1.c-5.

Table III.D.1.c-5

ESTIMATED EMISSIONS FROM ELK HILLS (KG/HR)

Source	THC[a]	RHC	SO_2	CO	TSP	NO_x
Tank Farm (fugitive)	23.0	6.9	0	0	0	0
Tanker loading (fugitive)	377	113[b]	0	0	0	0
Ship Exhaust	0.3	0.3[b]	2.8	Neg.	0.3	0.5
Tugboat Exhaust	Not Given		1.2	5.0	0.95	Not Given
Power Station	Not Given		21.8	Not Given	2.3	29.0

[a]Calculated using factors from EIS (URS Company).
[b]Values in EIS corrected.

Vaca Tar Sands. Vaca Tar Sands recovery project will be assumed to be producing a total of 22,329 bbl/d of oil in 1986 through 460 wells. The AeroVironment Report (1977) presents the assumptions and methodology in the calculations of emission rates. Table III.D.1.c-6 presents the emissions rates obtained.

Table III.D.1.c-6

VACA TAR SANDS EMISSION RATES (KG/HR)

Source	THC	NO_x	SO_2	CO	Particulates
Natural Gas Combustion	2.6	154	0.5	15.0	8.8
Residual Oil Combustion	18.5	370	490	24.7	142
Fugitive	14.3	0	0	0	0

MX Milestone II (Department of the Air Force, Final EIS MX: Milestone II, Vol. III: Missile Flight Testing ((Chas. 1, 3))

Emissions from this project are included for completeness, but they were not included in the modeling studies.

During the launch site construction phase, primary air impacts would be from vehicular emissions, as shown in Table III.D.1.c-7, and fugitive dust. Two types of launch operations (trench and shelter mode) are considered. Time of construction is expected to span 2 years. Fugitive dust factors are in the range of 0.6 to 1.2 tons per acre (1.34 to 2.69 metric tons/ha) per month of activity depending on the amount of dust control measure applied. For the shelter mode 25 acres (61 ha) for a potential dust generation rate of 15 to 30 tons (14 to 27 metric tons) and 90 to 180 tons (80 to 160 metric tons) per month, respectively.

Some twenty flight tests (4 or 5 per year) are expected to be launched from Vandenberg Air Force Base during 1983 through 1987. These missile launches will create a short-lived cloud of hydrogen chloride, aluminum oxide, carbon monoxide, carbon dioxide and water. Since the MX missile has not been finalized, the amounts of materials released from launch is not accurately known. The impact is estimated to be between that of the Minuteman and Titan III and the expected effluent about one-tenth that of the space shuttle.

Table III.D.1.c-7

VEHICULAR EMISSIONS FROM CONSTRUCTION OF MX: MILESTONE II LAUNCH SITES

(Metric tons/year)

Launch Configuration	HC	NO_x	SO_2	CO	TSP
Trench mode	19.7	31.6	2.1	189	2.4
Shelter mode	16.1	24.8	1.7	160	1.9

2. Modeling of Inert Pollutants

Modeling Approach. The analysis presented in this section does not include any offsets or other stipulations which may result from New Source Review (NSR). Since the applicability of NSR to OCS activities offshore is presently being determined in court, this impact section conservatively analyses the impact of Sale No. 48 without NSR.

Description of Models and Model Inputs. The pollutants TSP, SO_2, NO_2 and H_2S are modeled as inert pollutants. The concentrations due to inert pollutants were determined using several EPA developed computer models, namely PTMAX, PTMTP, and CDM. A pollutant is inert if its concentration does not change significantly by atmospheric chemical reactions. These pollutants behave in this manner except for NO_2. Although NO_2 is involved in the photochemical "smog" reactions, it is modeled as an inert pollutant to determine maximum impact. Impacts from photochemically derived pollutants, such as O_3, are determined using a different method and are addressed in the next section.

PTMAX is used to determine both the maximum concentration and the distance to maximum concentration for a point emission source. PTMTP produces hourly concentrations at various receptor locations resulting from emissions from many emission sources. CDM calculates long-term concentrations at many locations resulting from many sources. All of these models are Gaussian plume models.

The models used are recommended by EPA in Guidelines on Air Quality Models for use in applications similar to this one. In addition, the Committee on Atmospheric Turbulence and Diffusion has indicated in an AMS 1977 position paper (Bulletin of the American Meteorological Society, Vol. 59, No. 8, August 1978) that Gaussian plume models like these have accuracies within a factor of 2. Thus, the results presented in this section should be viewed with the accuracy in mind. These models assume that there are steady state meteorological conditions. Non-steady state conditions, like air flow reversal, may result in pollutants emitted earlier from Sale No. 48 facilities being transported back over the locations were impacts are being predicted. However, these conditions can be treated by the Gaussian plume models as a slight increase in the background concentration. Since the impacts are generally small compared to background, the impact of any flow reversal on predicted peak concentration should be within the accuracy of the model.

a. Model Inputs: To use the models described in the previous section, it was necessary to decide what meteorological conditions would produce the most realistic estimate of impacts for all sources and regions under consideration and to select the proper meteorology for each region. The regions considered are identified in Figure III.D.2.a-1. Three separate regions were analyzed because of differing meteorological influences. Regions I and II are significantly influenced by the land/ocean airflow while Region III is far enough away from the coast that the synoptic influences dominate. Although the onshore boundaries of Regions I and II are shown in Figure III.D.2.a-1 to be generally at the coastal mountains, the modeling actually encompassed the whole study area. The inert pollutant impacts farther inland were found to be essentially nonexistent, thus detailed analyses were not carried out there and will not be discussed here.

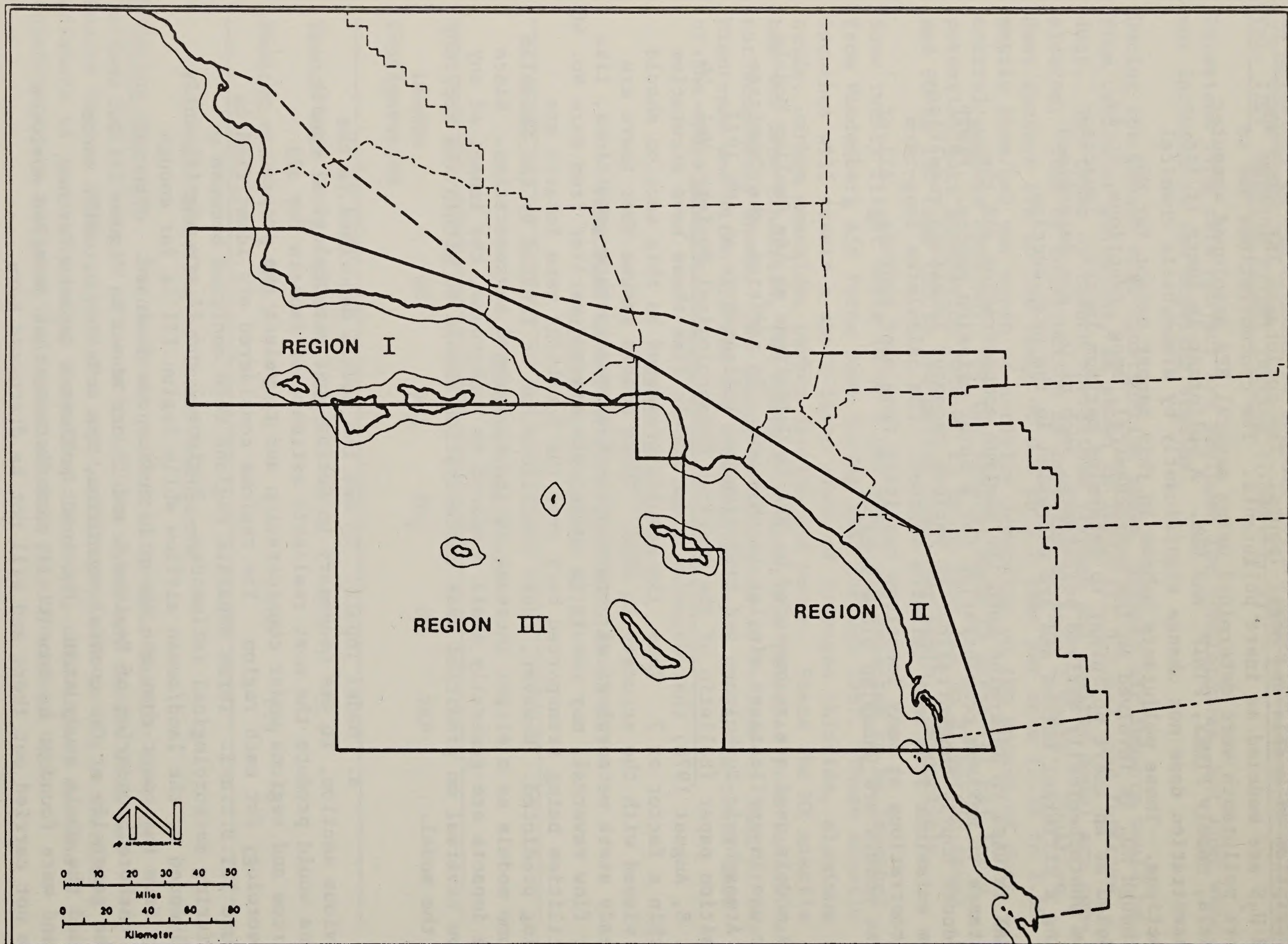


Figure III.D.2.a-1 Map Showing Region Delineation for Regional Analysis

Meteorology. In order to define the meteorology for use with PTMTP, sources were selected for each inert pollutant (SO_2, CO, TSP, NO_x) as representative sources in each of Regions I, II, and III. These sources include platforms, single buoy moors, and gas processing and oil processing facilities. Each of these cases was run on the PTMAX program to determine the meteorological condition which produced the maximum center line concentration and the location of the concentration. Meteorology was then identified which produced maximum concentrations for each source type. The results can be summarized roughly as follows.

Due to the indication that the persistence of stable meteorology might be unrealistic for larger buoyancy cases, the meteorology for the combined sources was selected to be of low wind speed and neutral stability. This meteorology is representative of the Southern California shoreline situation, especially for overcast periods, and represents conditions which would allow the pollutants to pass over coastal hills and spread into inland valleys, producing realistic impact situations with maximum concentrations at moderate ranges from the sources. The wind direction for offshore sources was always selected to produce the shortest path to the shoreline for Regions I and II. Region III is considered to be far enough from shore to be dominated by the usual offshore flow, which is generally parallel to the coastline, and does not impact on the mainland coast. Table III.D.2.a-1 lists the meteorology selected for inert pollutant modeling of the three regions.

Table III.D.2.a-1

WORST CASE METEOROLOGICAL CONDITIONS USED IN MODELING INERT POLLUTANTS

Region	Wind Direction	Wind Speed (m/s)	Stability Class	Mixing Height (m)
Region I	210°	0.5	4[a]	580
Region II	215°	0.6	4	580
Region III	300°	0.5	4	580

[a]Neutral stability defined by Pasquil-Gifford stability class designation (Turner, 1970).

For annual averages, the meteorology was determined using joint frequency distributions which were obtained locally for the region from STAR (Stability Array) data.

In this study, four different types of accidents were investigated, namely, small spill, large spill, blowout without fire and blowout with fire. Since oil spills do not result in the release of inert pollutants, modeling was only performed to assess photochemical pollutant impacts using REM2, as described in the next section. For the case of blowout without fire, H_2S would be the only inert pollutant being

released and, thus, downwind H_2S concentrations were calculated. For the case of blowout with fire, NO_2, CO, SO_2 and TSP would be emitted and were modeled.

Background Concentrations. Worst-case background concentrations in 1986 were determined by scaling maximum concentrations in 1975 by the ratio of 1986 emissions to 1975 emissions. Then, isopleths of worst-case background over the study area were obtained to allow interpolation at any point for which impact was to be determined. These isopleth plots and a more detailed discussion of background computation methodology are presented in the AeroVironment Report (1977).

Background. This approach to background concentrations is very conservative. The Clean Air Act stipulates that all areas must come up with plans which will allow attainment and maintenance with air quality standards by 1982 for NO_2, SO_2 and particulates and by 1987 for CO and oxidants. These plans should generally result in lower background concentrations than those assumed in this analysis. However, these plans have not been finalized and approved by EPA and thus are not available for this analysis. Thus, the conservative approach presented here was used.

If NSR would be applicable, then the NSR process would insure that all Sale No. 48 facilitiies constructed would be consistent with all Federal and State air quality laws and plans, including the ambient air quality standards. In particular, all onshore facilities would have to undergo NSR. Thus these facilities would have to be consistent with Attainment Plans for the affected non-attainment areas (see Section II.H.1.C for non-attainment areas). In order to be constructed, these facilities would have to obtain offsets (pollutant emission reductions in other existing sources) which would result in a "net air quality benefit."

The NSR process could result in some Sale No. 48 activities being significantly more expensive, or being blocked, since all offsets must be in addition to the emission reductions to be required by the Attainment Plans. For instance, since all of Southern California will have a significantly difficult time reaching attainment for oxidants, the offsets for hydrocarbon emissions from Sale No. 48 activities may be very difficult and expensive to obtain. If the offsets cannot be obtained economically, leasee may forego development. The specfic requirements or stipulations from NSR will not be known until the specific facilities from Sale No. 48 undergo NSR and, thus, cannot be analysed.

Philosophy. The approach used in this study was to first consider the impacts of all scenarios using the EPA models, and then, by adding in background, to determine which cases showed impacts approaching or exceeding the ambient air quality standards. This combination of largest OCS impact with worst-case background concentrations was used

to determine a conservative worst-case situation. Those cases which showed impacts far below the ambient air quality standards and which had no chance of approaching the standards, even if changes were made to the dispersion parameters, were eliminated from further consideration. The remaining cases were examined in more detail to determine if model assumptions were realistic and to identify which sources were causing exceedances. The results of these analyses are presented in the following sections.

b. Model Results (Regional Impacts): As a first approach, all the scenarios were run using the PTMTP model to identify the peak concentrations. Table III.D.2.b-1 lists all the scenarios considered and the maximum concentrations encountered. The scenario nomenclature is defined in Table III.D.2.b-2. A cursory examination of this table will identify those cases which have little impact and do not need further detailed consideration. Those cases with peak concentrations approaching or exceeding standards are indicated with an asterisk (*) and were considered in more detail.

CO. As shown in Table III.D.2.b-1, CO impact from Sale No. 48 is very low for both normal and 100 percent tankering scenarios. For Regions I and III the maximum background CO concentration at the maximum impact location for all scenarios with normal or 100 percent tankering is 5 ppm and less. With the maximum impact from the scenarios of less than 1 ppm, the resulting maximum concentrations are well under the Federal 1-hour standard of 35 ppm, and under the 8-hour standard of 9 ppm. In Region II, the 1-hour background CO concentration at the location of maximum impact in the San Pedro area is 10 ppm. The corresponding 8-hour background, however, is only 7 ppm. Adding the impact from the accident scenario of 0.7 ppm to these backgrounds still results in concentrations that are within the ambient air quality standards.

Table III.D.2.b-1

PEAK REGIONAL 1-HOUR AVERAGE CONCENTRATIONS

Pollutant	Region	Scenario[a]	Maximum Conc.	Maximum Located > 3 Mi. Offshore	Bkgnd. Conc. at Maximum	Total[b]
CO (ppm)	I	N48	< 0.1		4	4.0
		N48 + 48	< 0.1	Yes	4	4.0
		N48 + 48 + Other	0.1		5	5.1
		N48 + 48 + Acc	0.3	Yes	4	4.3
		N48T	< 0.1	Yes	4	4.0
		N48T + 48T	< 0.1	Yes	4	4.0
		N48T + 48T + Other	< 0.1		5	5.0
		N48T + 48T + Acc	0.3	Yes	4	4.3
	II	N48	< 0.1	Yes	4	4.0
		N48 + 48	< 0.1	Yes	4	4.0
		N48 + 48 + Other	< 0.1	Yes	4	4.0
		N48 + 48 + Acc at SD/Dana	1.3	Yes	4	5.3
		N48 + 48 + Acc at San Pedro	0.7		10	10.7*
		N48T	< 0.1	Yes	4	4.0
		N48T + 48T	< 0.1	Yes	4	4.0
		N48T + 48T + Other	< 0.1	Yes	4	4.0
		N48T + 48T + Acc at SD/Dana	1.3	Yes	4	5.3
		N48 + 48T + Acc at San Pedro	0.7		10	10.7*
	III	N48	< 0.1	Yes	4	4.0
		N48 + 48	< 0.1	Yes	4	4.0
		N48 + 48 + Acc	0.6	Yes	4	4.6
		N48T	< 0.1	Yes	4	4.0
		N48T + 48T	< 0.1	Yes	4	4.0
		N48T + 48T + Acc	0.6	Yes	4	4.6

Table III.D.2.b-1 (Cont.)

Pollutant	Region	Scenario[a]	Maximum Conc.	Maximum Located > 3 Mi. Offshore	Bkgnd. Conc. at Maximum	Total[b]
TSP ($\mu g/m^3$)	I	N48	12	Yes	50	62
		N48 + 48	12	Yes	50	62
		N48 + 48 + Other	417		190	607*
		N48 + 48 + Acc	63	Yes	50	113*
		N48T	14	Yes	50	64
		N48 + 48T	14	Yes	50	64
		N48T + 48T + Other	417		190	607*
		N48T + 48T + Acc	63	Yes	50	113*
	II	N48	2	Yes	120	122*
		N48 + 48	12	Yes	130	142*
		N48 + 48 + Other	12	Yes	130	142*
		N48 + 48 + Acc at SD/Dana	283	Yes	100	383*
		N48 + 48 + Acc at San Pedro	145		160	305*
		N48T	2	Yes	120	122*
		N48T + 48T	15	Yes	130	145*
		N48T + 48T + Other	15	Yes	130	145*
		N48T + 48T + Acc at SD/Dana	283	Yes	100	383
		N48T + 48T + Acc at San Pedro	145		160	305*
	III	N48	5	Yes	50	55
		N48 + 48	10	Yes	50	60
		N48 + 48 + Acc	91	Yes	50	141*
		N48T	7	Yes	50	57
		N48T + 48T	34	Yes	50	84
		N48T + 48T + Acc	91	Yes	50	141*

Table III.D.2.b-1 (Cont.)

Pollutant	Region	Scenario[a]	Maximum Conc.	Maximum Located > 3 Mi. Offshore	Bkgnd. Conc. at Maximum	Total[b]
SO_2 (ppm)	I	N48	0.01	Yes	.02	.03
		N48 + 48	0.01	Yes	.02	.03
		N48 + 48 + Other	0.55		.03	.58*
		N48 + 48 + Acc	0.08	Yes	.02	.10
		N48T	0.01	Yes	.02	.03
		N48T + 48T	0.18	Yes	.02	.20
		N48T + 48T + Other	0.55		.03	.58*
		N48T + 48T + Acc	0.18	Yes	.02	.20
	II	N48	> 0.01		.23	.23
		N48 + 48	0.01	Yes	.08	.09
		N48 + 48 + Other	0.01	Yes	.08	.09
		N48 + 48 + Acc at SD/Dana	0.34	Yes	.08	.42*
		N48 + 48 + Acc at San Pedro	0.15	Yes	.12	.27
		N48T	> 0.01		.23	.23
		N48T + 48T	0.01	Yes	.08	.09
		N48T + 48T + Other	0.01	Yes	.08	.09
		N48T + 48T + Acc at SD/Dana	0.34	Yes	.08	.42*
		N48T + 48T + Acc at San Pedro	0.17	Yes	.12	.29
	III	N48	> 0.01	Yes	.02	.02
		N48 + 48	> 0.01	Yes	.02	.02
		N48 + 48 + Acc	0.19	Yes	.02	.21
		N48T	> 0.01	Yes	.02	.02
		N48T + 48T	0.22	Yes	.02	.24
		N48T + 48T + Acc	0.23	Yes	.02	.25

Table III.D.2.b-1 (Cont.)

Pollutant	Region	Scenario[a]	Maximum Conc.	Maximum Located > 3 Mi. Offshore	Bkgnd. Conc. at Maximum	Total[b]
NO_2 (ppm)	I	N48	0.37		.02	.47*
		N48 + 48	0.56		.10	.66*
		N48 + 48 + Other	0.56		.10	.66*
		N48 + 48 + Acc	0.56		.10	.66*
		N48	0.03	Yes	.02	.05
		N48T + 48T	0.05	Yes	.02	.07
		N48T + 48T + Other	0.52		.08	.60*
		N48T + 48T + Acc	0.06	Yes	.02	.08
	II	N48	0.01		.30	.31*
		N48 + 48	0.06	Yes	.18	.23*
		N48 + 48 + Other	0.06	Yes	.18	.24*
		N48 + 48 + Acc at SD/Dana	0.07	Yes	.02	.09
		N48 + 48 + Acc at San Pedro	0.07	Yes	.18	.25*
		N48T	0.01		.30	.31*
		N48T + 48T	0.06	Yes	.18	.24*
		N48T + 48T + Other	0.09	Yes	.18	.29*
		N48T + 48T + Acc at SD/Dana	0.08	Yes	.02	.10
		N48T + 48T + Acc at San Pedro	0.08	Yes	.12	.20
	III	N48	0.01	Yes	.02	.03
		N48 + 48	0.04	Yes	.02	.06
		N48 + 48 + Acc	0.04	Yes	.02	.06
		N48T	0.02	Yes	.02	.04
		N48T + 48T	0.06	Yes	.02	.08
		N48T + 48T + Acc	0.07	Yes	.02	.09

Table III.D.2.b-1 (Cont.)

Pollutant	Region	Scenario[a]	Maximum Conc.	Maximum Located > 3 Mi. Offshore	Bkgnd. Conc. at Maximum	Total[b]
H_2S	I	N48	0.004	No	0.0	0.004
		N48 + 48	0.004	No	0.0	0.004
		N48 + 48 + Acc	0.10	Yes	0.0	0.10 *
		N48T	0.002	No	0.0	0.002
		N48T + 48T	0.002	No	0.0	0.002
		N48T + 48T + Acc	0.10	Yes	0.0	0.10 *

[a]See Table III.D.2.b-2 for nomenclature.
[b]Values identified with an * are discussed in more detail in the text.

Table III.D.2.b-2

EXPLANATION OF SYMBOLS USED IN THE PREVIOUS TABLE

Symbol	Definition
N48	Base level - includes changes in existing and Sale 35 oil and gas development activities; assumes normal tankering of oil and gas.
N48T	Base level - includes changes in existing and Sale 35 oil and gas development activities; assumes 100% tankering of oil and gas.
48	Sale 48 - assumes normal tankering of oil and gas.
48T	Sale 48 - assumes 100% tankering of oil and gas.
Acc	Accidents - two types are analyzed: blowout without fire and blowout with fire.
Other	Other proposed actions: 1) In Region I, two sets of other proposed actions are studied. The first set includes the Space Shuttle Program, the LNG terminal at Point Conception, the Vaca Tar Sands Project and the Elk Hills Project. The second set assumes that the LNG Terminal would be at Oxnard instead of at Point Conception. 2) In Region II, the other proposed action is the SOHIO Project. 3) There are no other proposed actions in Region III.

TSP. The ambient air quality standards for TSP include one for a 24-hour period as well as an annual geometric mean standard. Although no hourly TSP standard is listed for California or nationally, TSP was initially analyzed for an hourly average to test the severity of the TSP problem. Any scenario which is below the 24-hour standards during the worst-case hour should satisfy 24-hour requirements, since the varied 24-hour meteorology will reduce the concentrations in any given direction. Cases which indicated high hourly values were examined more closely and reanalyzed if required on a 24-hour basis and annual basis to determine if standards were actually violated.

For Region I, the peak impact of Sale No. 48 occurs beyond 5.56 km (3 miles) from shore. The background TSP concentration is 50 $\mu g/m^3$ at the maximum impact location. The maximum impact from base level plus Sale No. 48 with normal tankering is 12 $\mu g/m^3$ for 1 hour average. Thus, the sum is 62 $\mu g/m^3$ - well below the California 24-hour standard of 100 $\mu g/m^3$. The two cases which have larger impacts and background concentrations are the combination of base level, Sale No. 48 and other major projects with normal and 100-percent tankering. Figure III.D.2.b-1 is an isopleth plot of the worst-case TSP impacts in Region I for Sale No. 48 with normal tankering plus other major projects, not including background. The plus signs on the plot indicate the coastline and Channel Islands. The maximum isopleths are located in the Ventura area in the vicinity of the Vaca Tar Sands Project. For both cases, the 24-hour average was determined to be about 83 $\mu g/m^3$ with maximum 24-hour background value of 190 $\mu g/m^3$ there. Thus, the expected 24-hour maximum concentration is expected to total 273 $\mu g/m^3$. However, the contribution from Sale No. 48 to this total is insignificant (<1 $\mu g/m^3$).

Region II has maximum 24-hour and annual geometric mean background TSP concentrations above the respective standards even beyond 5.56 km (3 miles) from shore. Thus, several scenarios which indicated high concentrations in Table III.D.2.b-2 were analyzed to determine 24-hour and annual averages. The maximum 24-hour impact above background from normal operations associated with Sale No. 48 is about 3 $\mu g/m^3$ for normal tankering and 4 $\mu g/m^3$ for 100-percent tankering located beyond 5.56 km (3 miles) from shore. The maximum 1-hour impact in Region II from the various scenarios is under the accident scenarios, which results in 145 to 283 $\mu g/m^3$ maximum concentration above background. These result, adding background values, in concentrations of 305 to 383 $\mu g/m^3$. Because the accident is the major TSP emission source, there is no difference in the maximum impact between normal and 100-percent tankering. The maximum regional 24-hour impact of the accident value was 33 $\mu g/m^3$. Thus, with maximum 24-hour background, the accident located in San Pedro could result in a 24-hour TSP concentration of 193 $\mu g/m^3$.

In Region III, the impacts are all located well out to sea. The accident scenario was the only one resulting in 1-hour average TSP concentrations above the State standard of 100 $\mu g/m^3$. The 24-hour average

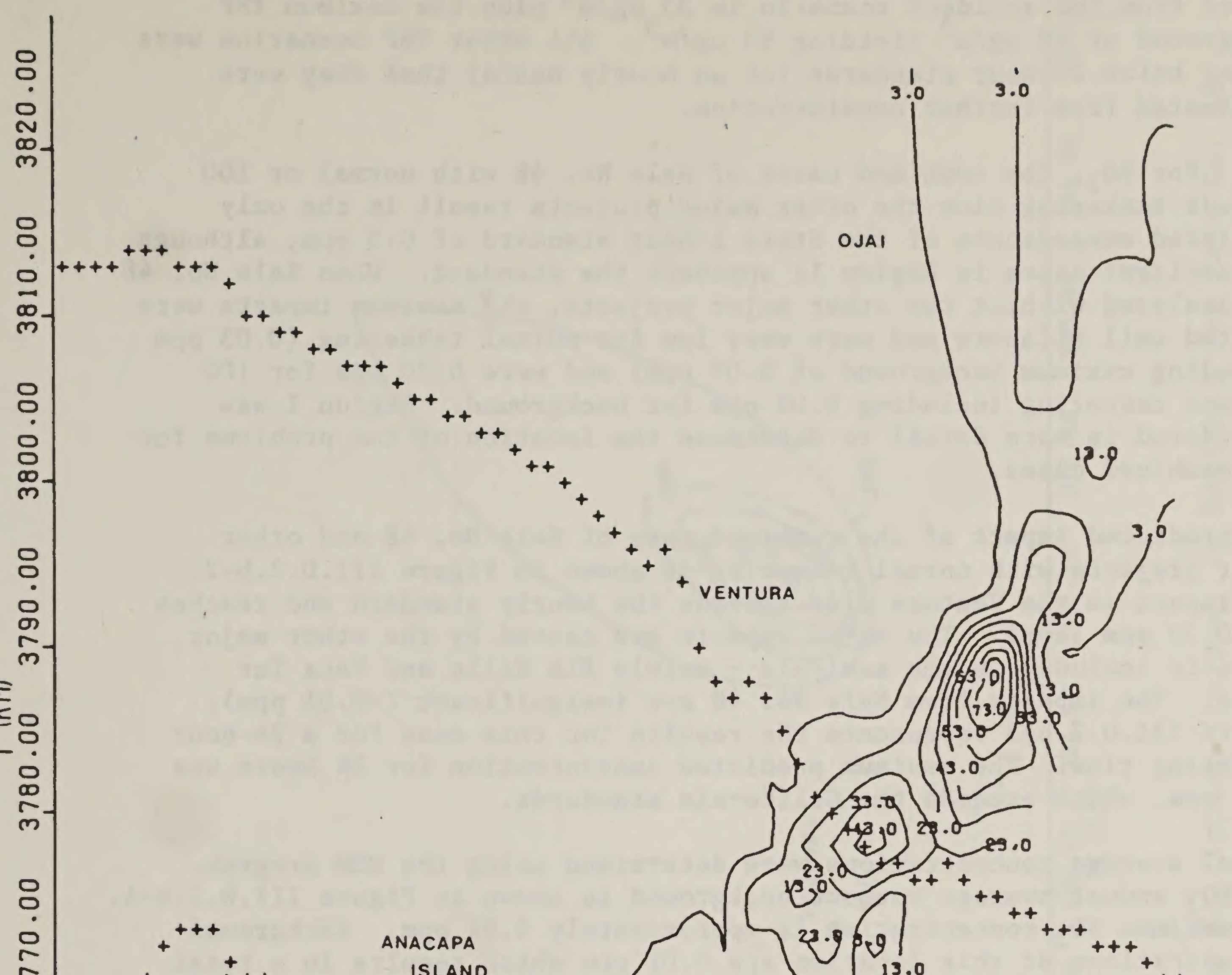


Figure III.D.2.b-1 Above-background 24-hour TSP Impact in Region I from the Combination Base Level and Sale No. 48 Activities With Normal Tankering and Other Proposed Projects

impact from the accident scenario is 33 $\mu g/m^3$ plus the maximum TSP background of 50 $\mu g/m^3$ yielding 83 $\mu g/m^3$. All other TSP scenarios were so far below 24-hour standards (on an hourly basis) that they were eliminated from further consideration.

SO_2. For SO_2, the combined cases of Sale No. 48 with normal or 100 percent tankering plus the other major projects result in the only predicted exceedances of the State 1-hour standard of 0.5 ppm, although the accident cases in Region II approach the standard. When Sale No. 48 was analyzed without the other major projects, the maximum impacts were located well offshore and were very low for normal tankering (0.03 ppm including maximum background of 0.02 ppm) and were 0.20 ppm for 100 percent tankering including 0.02 ppm for background. Region I was considered in more detail to determine the location of the problems for the combined cases.

The predicted impact of the combined case of Sale No. 48 and other major projects with normal tankering is shown in Figure III.D.2.b-2. The impact in the Ventura area exceeds the hourly standard and reaches the 0.55 ppm level. The major impacts are caused by the other major projects included in the analysis - mainly Elk Hills and Vaca Tar Sands. The impacts from Sale No. 48 are insignificant (<0.01 ppm). Figure III.D.2.b-3 represents the results for this case for a 24-hour averaging time. The maximum predicted concentration for 24 hours was 0.12 ppm, which exceeds the California standards.

Annual average concentrations were determined using the CDM program. The SO_2 annual average without background is shown in Figure III.D.2.b-4. The maximum SO_2 concentration is approximately 0.01 ppm. Background concentrations at this location are 0.01 ppm which results in a total of 0.02 ppm, which is about two thirds of the Federal annual average standard of 0.03 ppm. The accident cases for Region II approach the standard. The accident impacts are further discussed below in the discussion of impacts of specific sources.

Sulfates. There are no widely accepted models which quantify sulfate concentrations impacts from sulfur emissions. Sulfates are formed in ambient air by chemical transformations of SO_2 to sulfate. Based on EPA and TVA studies, the conversion rate of SO_2 to sulfates is between ½ percent to 5 percent, with more sulfate being formed under high humidity. One method of quantifying Sale No. 48 impacts on sulfates is to relate Sale No. 48 sulfur emissions to existing sulfur emissions.

Table III.D.2.a-1 presents Sale No. 48 sulfur emissions as a percentage of the impacted county emissions. Sale No. 48 emissions are less than 1 percent of total SO_2 emissions in the entire Southern California study area. However, specific counties may have larger impacts since SO_2 emissions from Sale No. 48 are quite significant compared to Santa Barbara and Ventura emissions. Exceedances of California's standard of 25 $\mu g/m^3$ are shown in Table II.H.1-9 for 1975-77. Thus, Sale No. 48 emissions of SO_2 could have some impact on attainment of the California Standard.

NO_2. For NO_2, the conservative assumption that all NO_x emissions are NO_2 was used in this analysis. This assumption results in overprediction of the actual NO^2 values to be expected. The NO_2 modeling results, in Table III.D.2.b-2, show that all normal tankering cases for Region I, including the base level case, exceed the State 1-hour standard. For

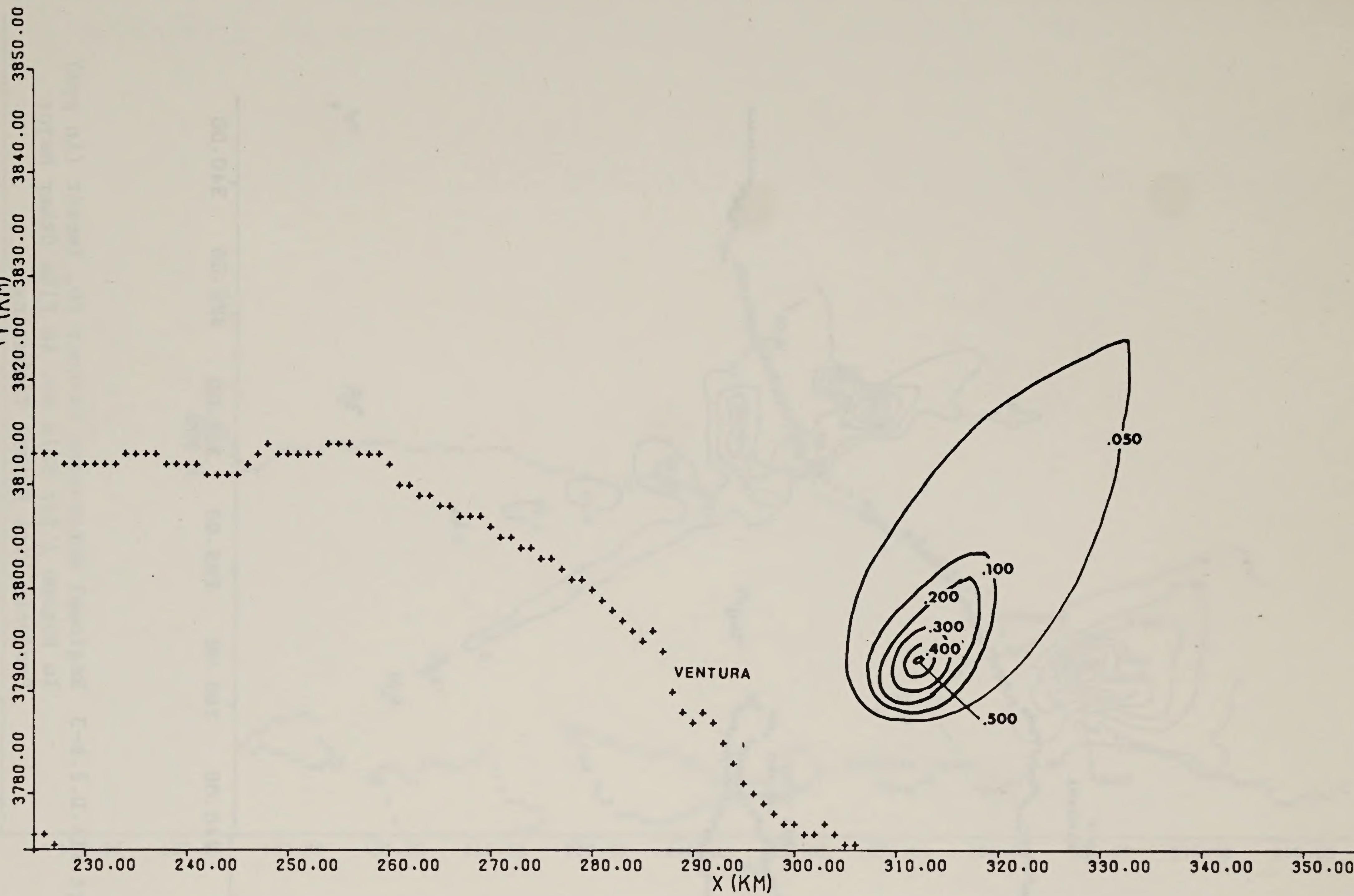


Figure III.D.2.b-2 Regional Worst-case 1-hour SO_2 Impact (in ppm) In Region I for Sale No. 48 Plus Other Major Projects for Normal Tankering

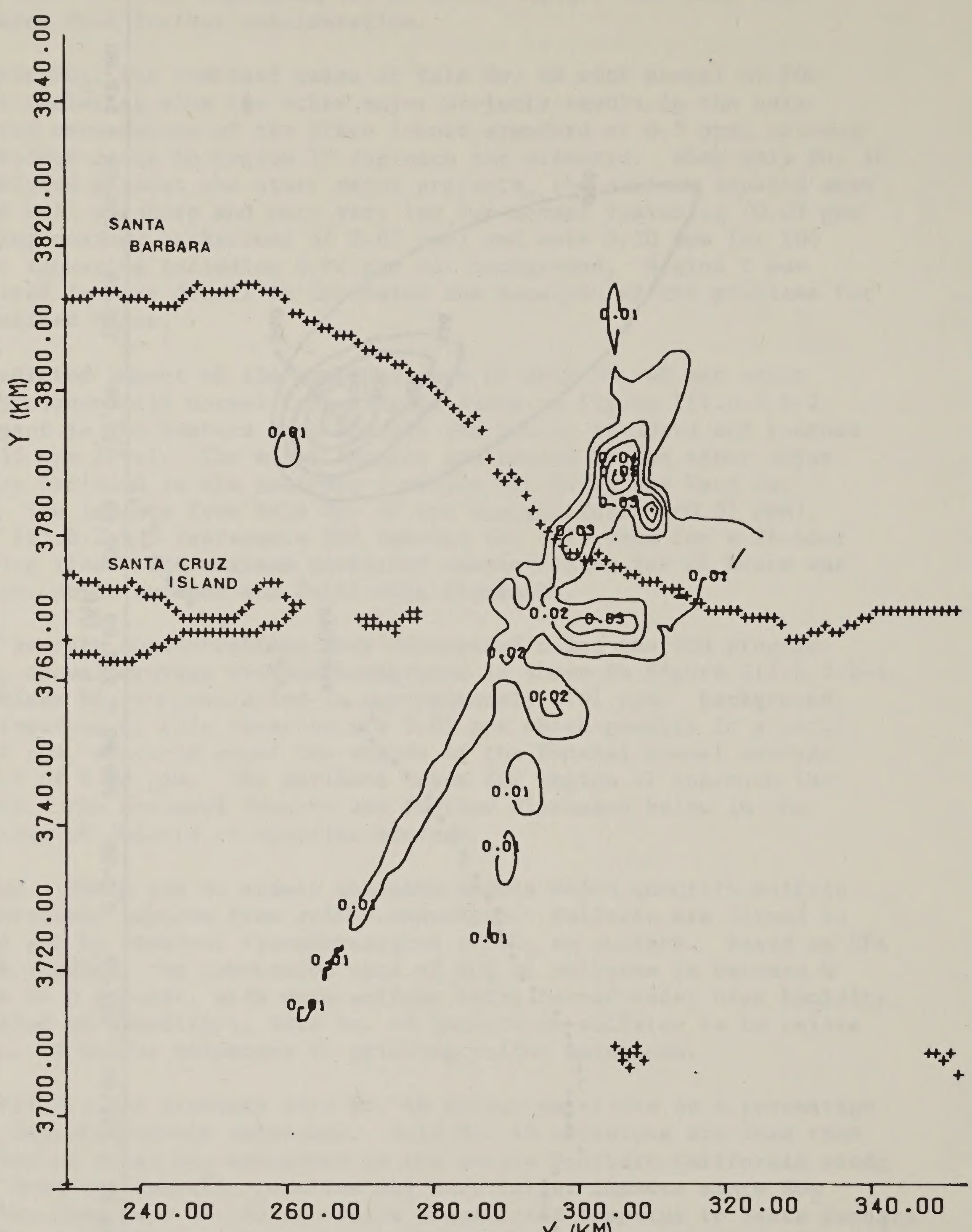


Figure III.D.2.b-3 Regional Worst-case 24-hour SO_2 Impact (in ppm) In Region I for Sale No. 48 Plus Other Major Projects With Normal Tankering

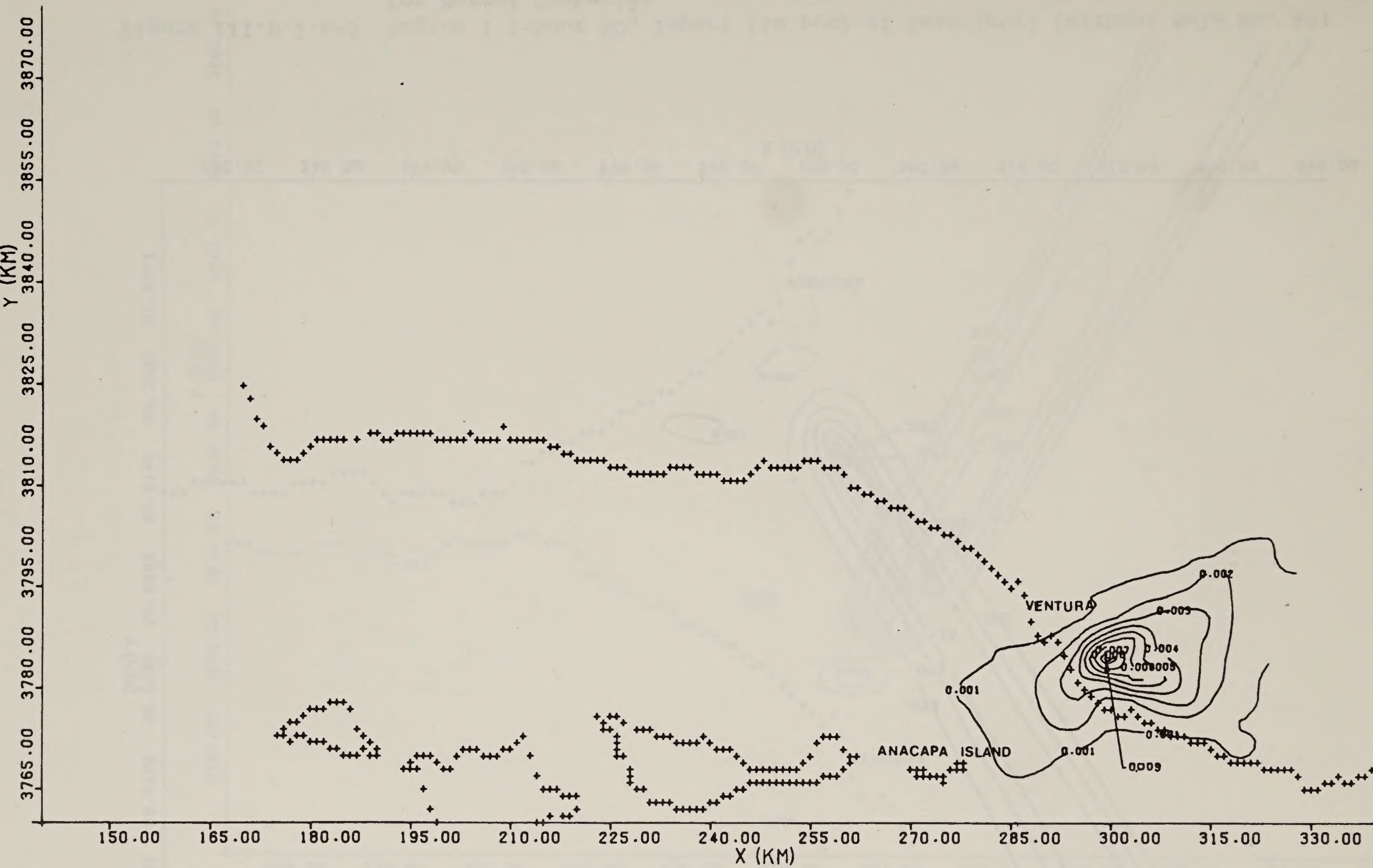


Figure III.D.2.b-4 Regional Annual Average SO_2 Impact (in ppm) In Region I for Sale No. 48 Plus Other Major Projects With Normal Tankering

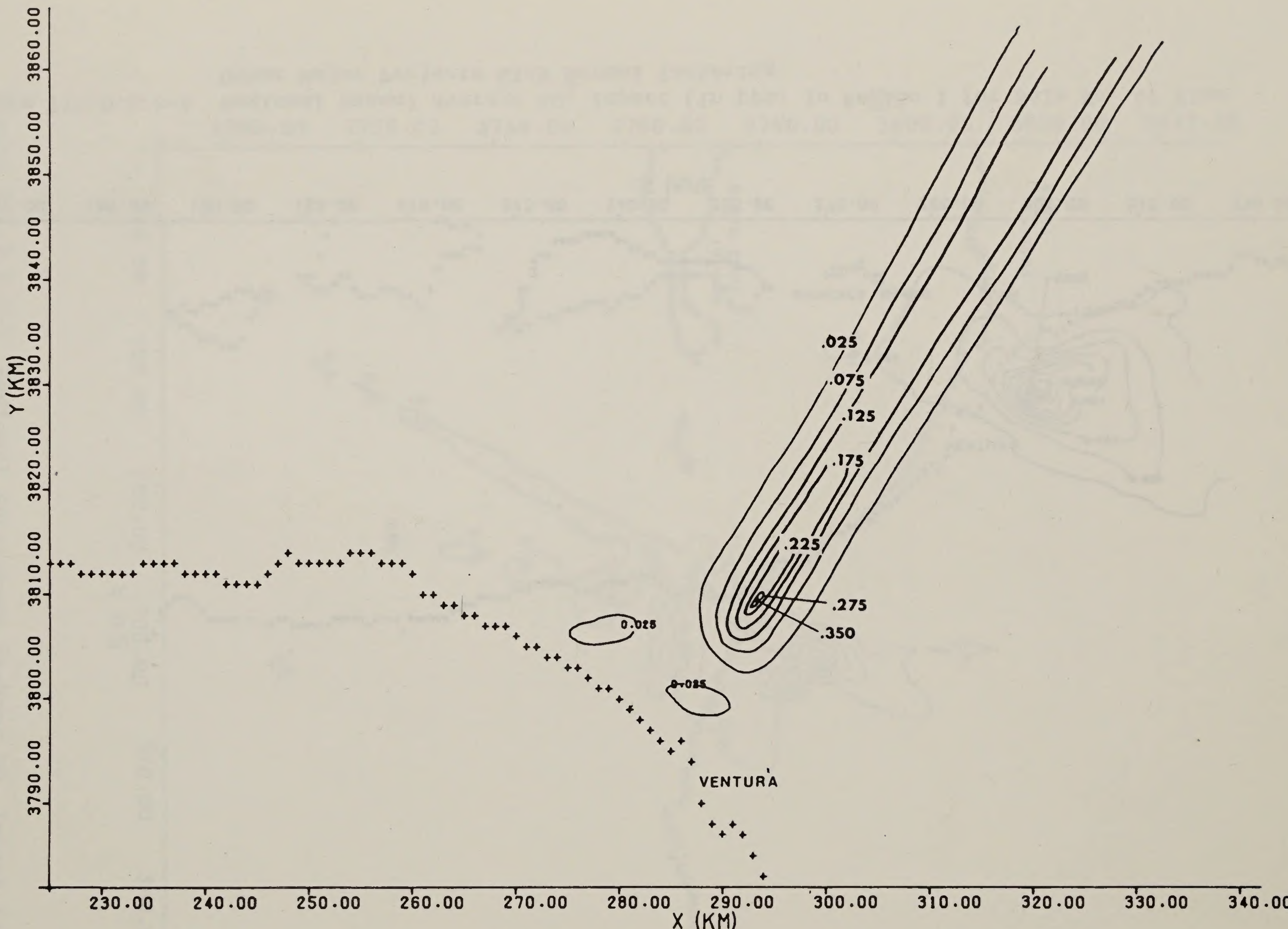


Figure III.D.2.b-5 Region I 1-hour NO_2 Impact (in ppm) of Base-level (without Sale No. 48) for Normal Tankering

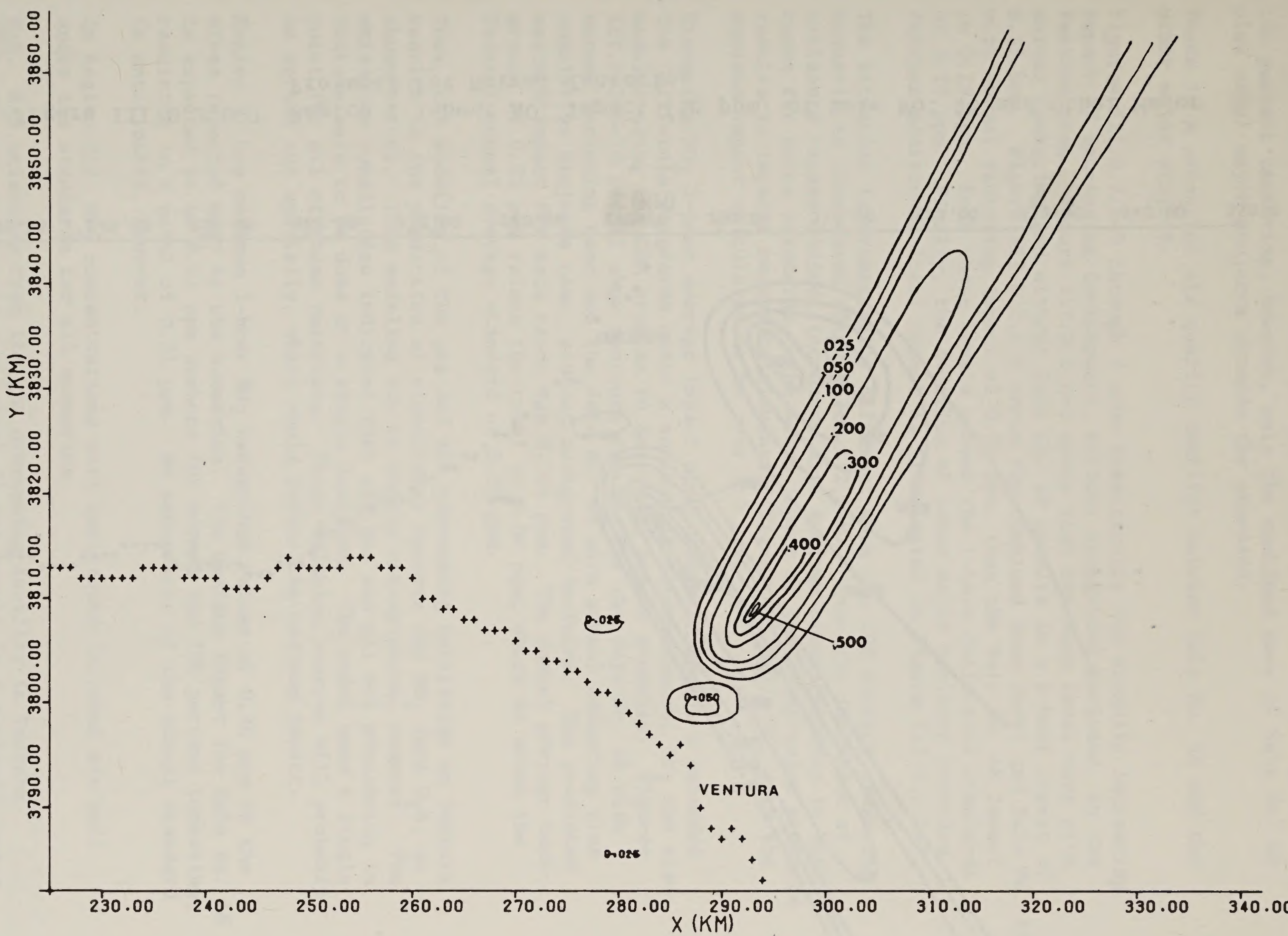


Figure III.D.2.b-6 Region I 1-hour NO_2 Impact (in ppm) of Sale No. 48 for Normal Tankering

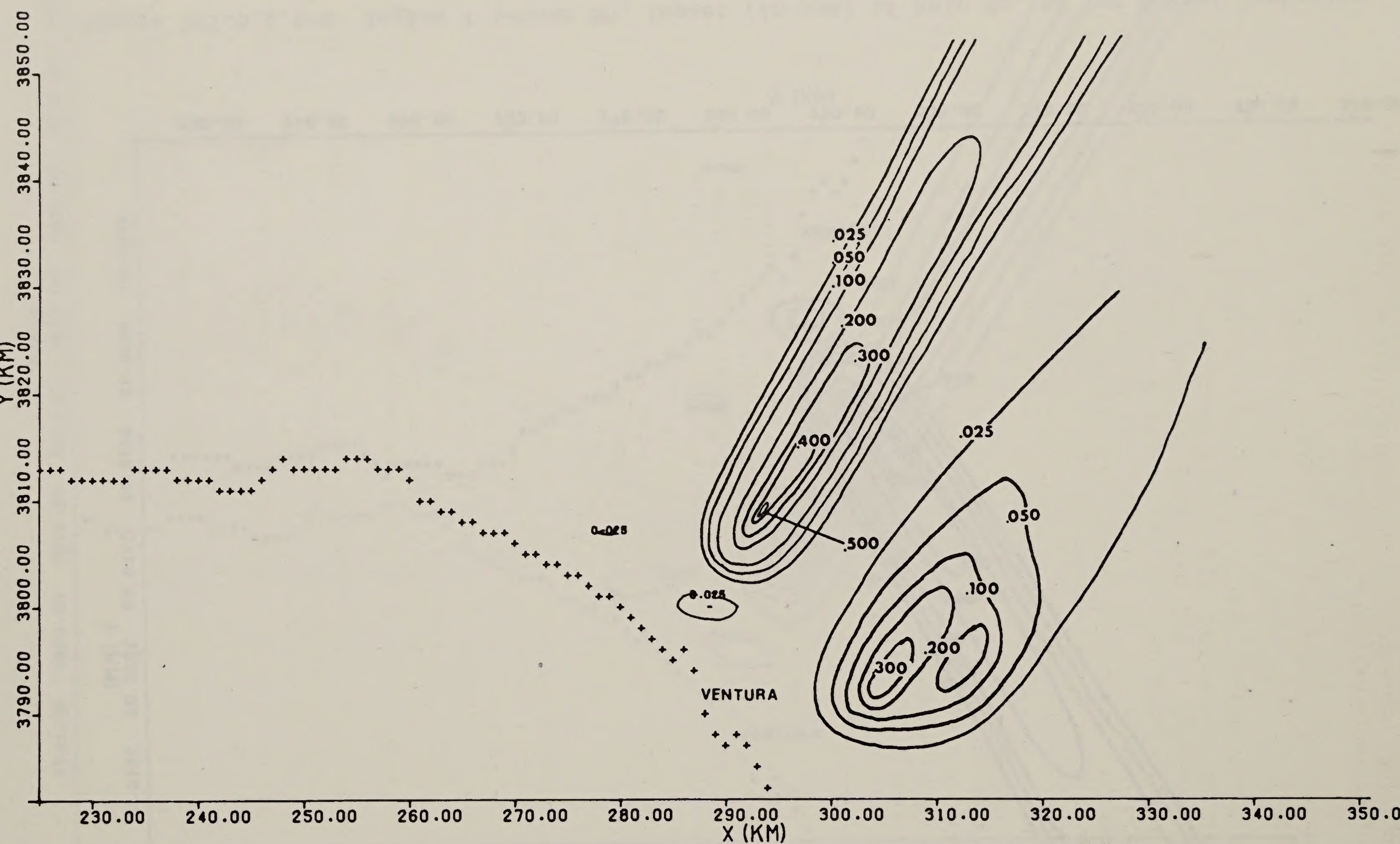


Figure III.D.2.b-7 Region I 1-hour NO_2 Impact (in ppm) of Sale No. 48 and Other Major Projects for Normal Tankering

100 percent tankering, however, only the combined case of Sale No. 48 plus other major projects exceeds the standard.

There is a potential air quality conflict between Sale No. 48 and the other major project.

Figures III.D.2.b-5 through 7 show dramatically the steadily increasing impact of increasing development, without background included, in the Ventura area. Figure III.D.2.b-5 shows that the base level case with normal tankering and without Sale No. 48 results in a 1-hour impact of 0.37 ppm. Figure III.D.2.b-6 shows the combined base level and Sale No. 48 with normal tankering impact of 0.56 ppm, thus the Sale No. 48 impact is 0.19 ppm. Both these levels exceed the 1-hour California standards of 0.25 ppm. Finally, the addition of other major projects provides further additional local impact as illustrated in Figure III.D.2.b-7.

The situation is dramatically different when the 100 percent tankering scenario is considered (Figure III.D.2.b-8). Even the inclusion of accidents causes minimal increases with maximum concentrations in both cases far below standards. The added impact of the other major projects results in impacts exceeding standards (Figure III.D.2.b-9), with the maximum impact calculated to be over 0.5 ppm.

Since the NO_2 1-hour average impact predictions in Region I exceeded the California standards under a variety of circumstances, NO_2 was also modeled using the CDM program to determine annual averages. Figures III.D.2.b-10 and 11 show contours for NO_2 for the Sale No. 48 with normal tankering case and the Sale No. 48 with normal tankering plus cumulative projects case, without background included. The predicted maximum impact for both cases was 0.034 ppm. The annual average background of 0.03 ppm raises the total to 0.06 ppm, which is above the Federal annual average standard of 0.05 ppm.

Thus, the modeling of the gas and oil processing facilities in Ventura results in the prediction of significant impacts for NO_2 (and H_2S, as shown below). This modeling may be overly conservative, however. The emissions compilation indicated that all gas and all oil processing in Ventura were to be done at a single location. The model used a single point for all of these emissions. These emission sources will probably be spread out spatially, which would reduce the maximum impact.

Region II has maximum 1-hour NO_2 background values of 0.30 ppm in the areas impacted most by the scenarios. The maximum impact for Sale No. 48 is expected to be 0.01 ppm onshore for normal and 100 percent tankering, resulting in a total of 0.31 ppm. No exceedance of the annual standard is anticipated, however.

In Region III, NO_2 concentrations with background included are well under the standards for all scenarios.

$\underline{H_2S}$. H_2S emissions from the gas processing facility in Ventura (Sale No. 48 with normal tankering) do not result in a regional impact onshore; localized impacts are discussed later. With 100 percent tankering, the H_2S emissions associated with normal operation of Sale No. 48 are removed. The comment in the NO_2 discussion above, about the conservativeness of the impact modeling of this facility, also applies here.

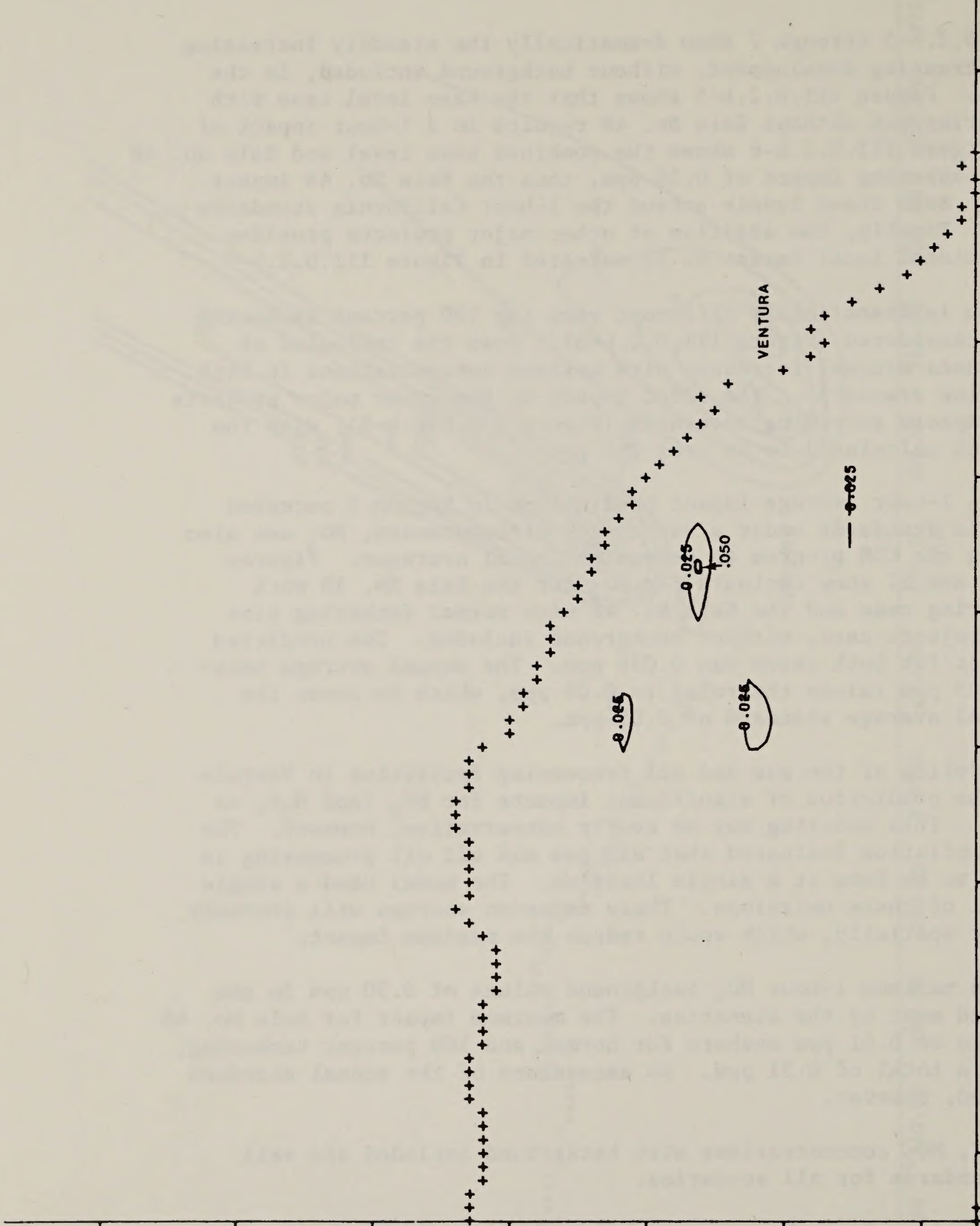


Figure III.D.2.b-8 Region I 1-hour NO_2 Impact (in ppm) of Sale No. 48 With 100% Tankering

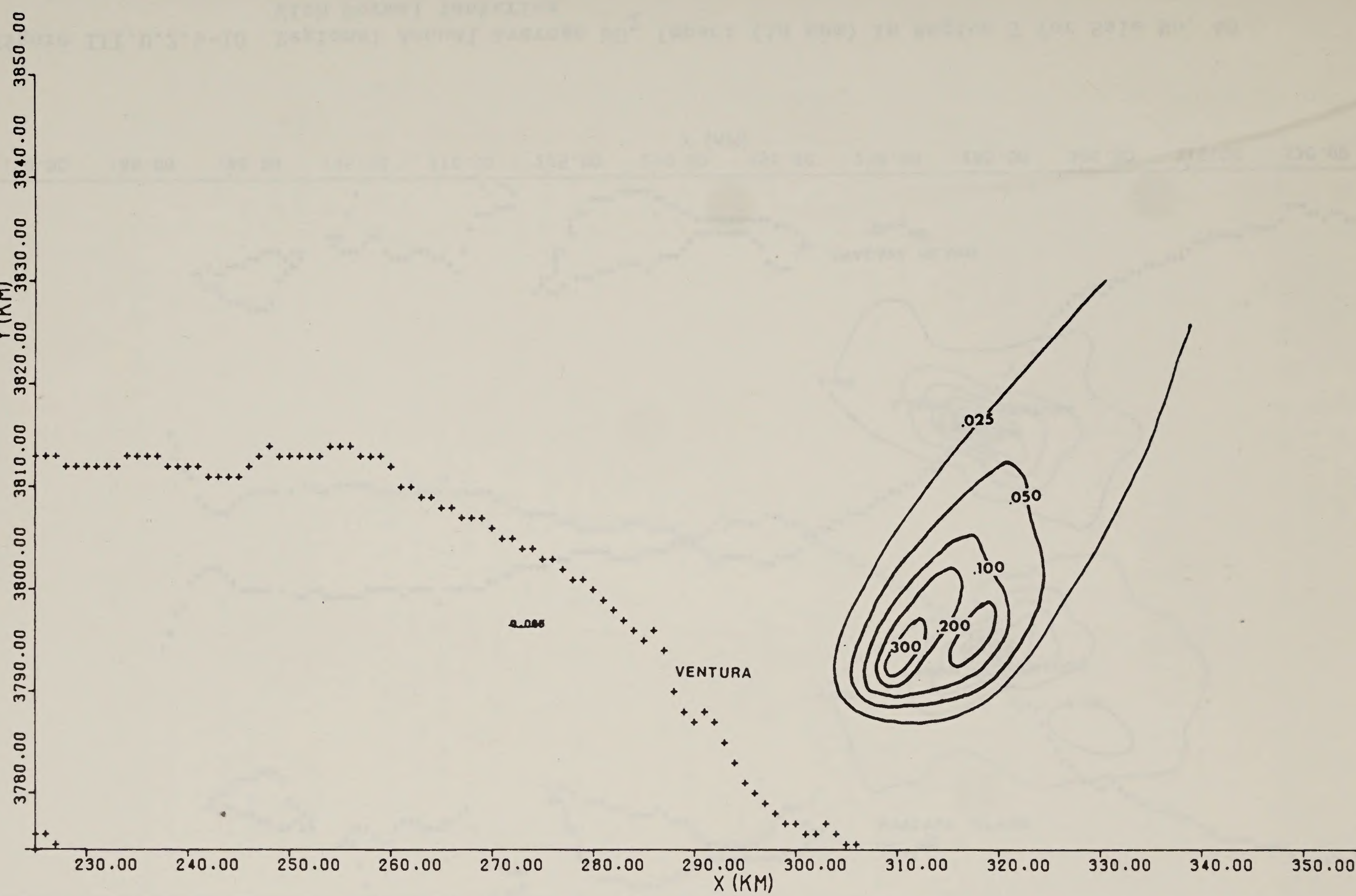


Figure III.D.2.b-9 Region I 1-hour NO_2 Impact (in ppm) of Sale No. 48 With Other Major Projects for 100% Tankering

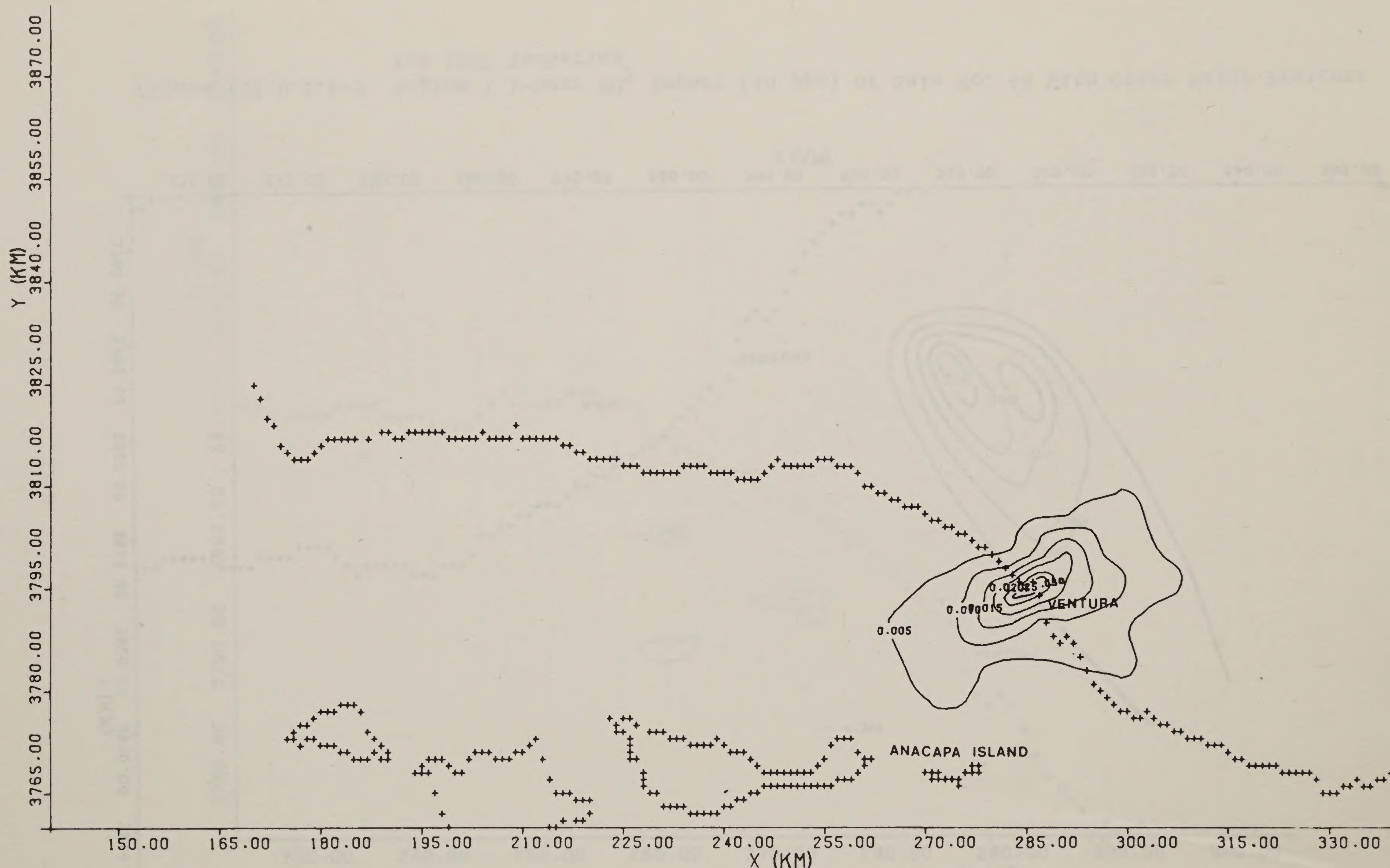


Figure III.D.2.b-10 Regional Annual Average NO_2 Impact (in ppm) in Region I for Sale No. 48 With Normal Tankering

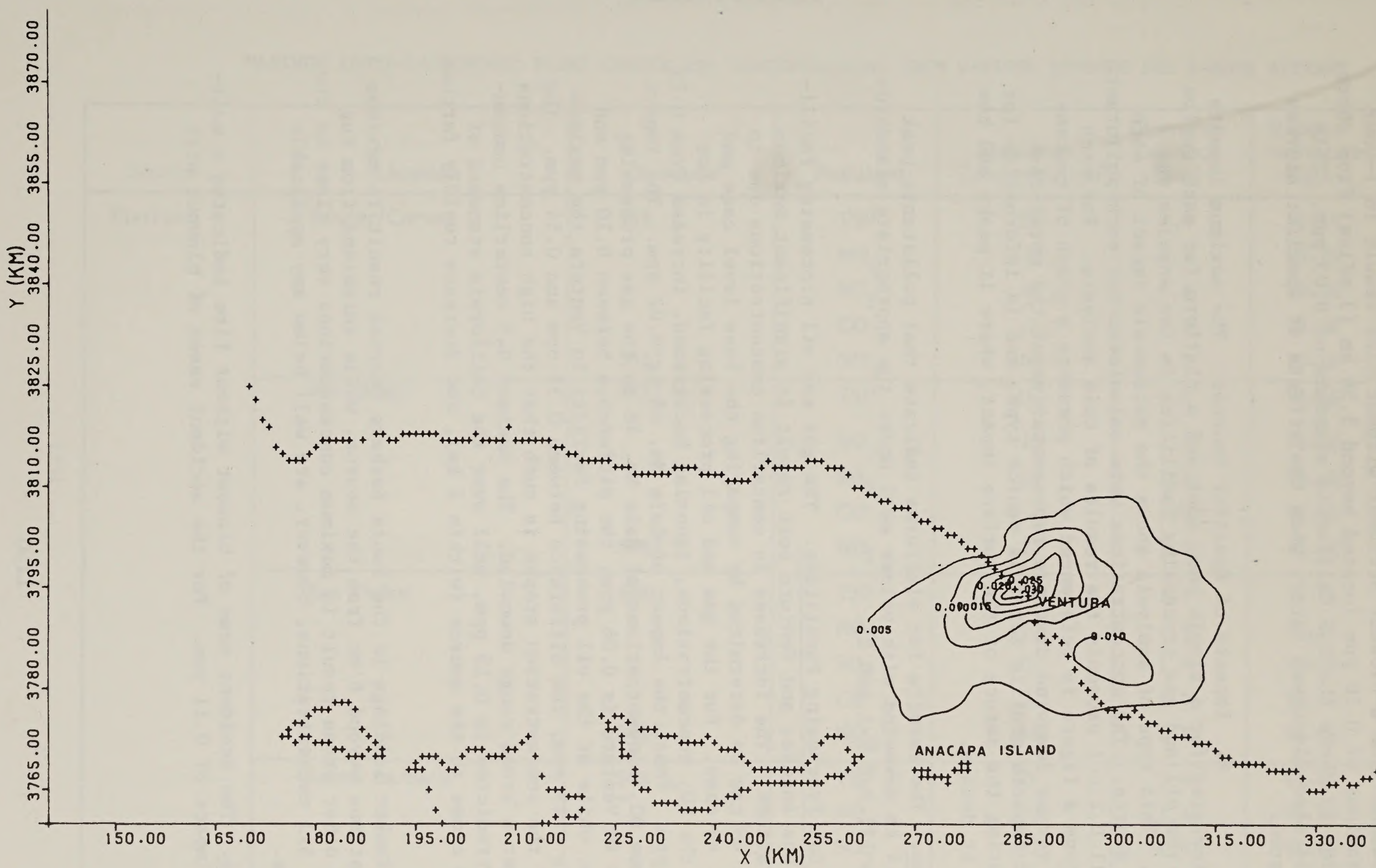


Figure III.D.2.b-11 Regional Annual Average NO_2 Impact (in ppm) In Region I for Sale No. 48 Plus Other Major Projects

H_2S emissions from a blowout accident without fire result in 1-hour concentrations of 0.10 ppm located beyond 5.56 km (3 miles) from shore. This value is above the H_2S California standard of 0.03 ppm. This impact is also discussed later, when the effects of specific sources are treated.

c. Impacts of Specific Sources: The maximum impacts were calculated for a single buoy moor and a platform for each region and for the oil and gas processing facilities in Los Angeles and Ventura. This type of analysis shows the microscale impact of each type of source. The concentrations were calculated for each pollutant. Table III.D.2.c-1 presents the results of this analysis. For each source type a figure is referenced which presents a graph of concentration versus downwind distance representative of the worst-case downwind impacts profile for this source type, and is informative for illustrating the nature of the surface impact, where it peaks and how rapidly it decays.

Platforms. The results for platforms indicate that pollutants peak about 1.4 km downwind with values well under the appropriate standards (Figures III.D.2.c-1 and 2).

Oil and Gas Processing Facilities. The gas and oil processing facilities in Los Angeles and Ventura both result in significant maximum concentrations. The increases in centerline concentrations due to Sale No. 48 can be determined by comparing the base level case and Sale No. 48 case. For the gas and oil processing facility in Los Angeles the NO_2 concentrations, ignoring background, increase from 0.21 to 0.23 ppm. Thus, the impact of Sale No. 48 is 0.02 ppm. The impact on maximum NO_2 concentrations of Sale No. 48 on the gas processing facility in Ventura is 0.06 ppm, the difference between 0.10 ppm and 0.16 ppm; while at the oil processing facility in Ventura the maximum impact is 0.19 ppm, the difference between 0.35 ppm and 0.54 ppm. The shape of the concentration graphs is such that the high concentrations occur over a broad range downwind. The maximum H_2S centerline concentration predicted is 0.15 ppm, well over the California standard of 0.03 ppm close to the source (within 2 km), and decrease rapidly farther away.

SBM's. Tanker loadings in the Santa Barbara Channel result in maximum concentrations beyond 8 km from the source, while emissions from tug boats in other areas result in maximum concentrations very close to the source. All concentrations, however, are well below any applicable standards.

Accidents. The accident case of blowout without fire indicates a maximum H_2S impact of 0.11 ppm. For the accident cases of blowout with

Table III.D.2.c-1

MAXIMUM ABOVE-BACKGROUND PLUME CENTERLINE CONCENTRATIONS FROM VARIOUS SOURCES FOR 1-HOUR AVERAGE

Source	Location	Scenario[a]	Pollutant	Maximum Concentration[b]	Downwind Distance (km)	Representative Figure
Platform	Tanner/Cortez	S48	TSP	28	1.4	VI-16
			NO_2	.17	1.4	VI-16
			SO_2	.01	1.4	VI-16
			CO	.1	1.4	VI-16
		S48T	NO_2	.06	3.2	VI-16
	San Diego	S48T	TSP	16	1.4	VI-16
			NO_2	.10	1.4	VI-16
			SO_2	.01	1.4	VI-16
			CO	< .1	1.4	VI-16
		S48T	NO_2	.10	1.4	VI-16
	San Pedro	S48	TSP	24	1.4	VI-16
			NO_2	.10	1.4	VI-16
			SO_2	.01	1.4	VI-16
			CO	.1	1.4	VI-16
		S48T	NO_2	.10	1.5	VI-16
	Santa Barbara	S48	TSP	33	1.4	VI-16
			NO_2	.03	1.4	VI-16
			SO_2	.01	1.4	VI-16
			CO	.01	1.4	VI-16
		S48T	NO_2	< .01	10.9	VI-16

Table III.D.2.c-1 (Cont.)

Source	Location	Scenario[a]	Pollutant	Maximum Concentration[b]	Downwind Distance (km)	Repre-sentative Figure
SBM	Santa Barbara Island	S48	TSP	5	.5	VI-15
			NO_2	.01	3.	VI-16
			SO_2	< .01	.5	VI-15
			CO	< .1	.5	VI-15
		S48T	NO_2	.01	3	VI-16
	Santa Barbara Channel	S48	TSP	4	8.5	VI-16
			NO_2	< .01	8.5	VI-16
			SO_2	.03	8.5	VI-16
			CO	< .1	8.5	VI-16
		S48T	NO_2	.11	3	VI-16
	San Diego	S48	TSP	4.5	.5	VI-1
			NO_2	.02	2.5	VI-16
			SO_2	< .01	.5	VI-15
			CO	< .1	.5	VI-15
		S48T	NO_2	.02	2.5	VI-16
Accidents	--	with fire	TSP	1380[d]	1	VI-16
			NO_2	.25 [d]	1	VI-16
			SO_2	1.64[d]	1	VI-16
			CO	6.3 [d]	1	VI-16
		without fire	H_2S	.11	1.4	VI-16

Table III.D.2.c-1 (Cont.)

Source	Location	Scenario[a]	Pollutant	Maximum Concentration[b]	Downwind Distance (km)	Representative Figure
Gas & Oil Processing	Los Angeles	N48T	TSP	39	.5	VI-15
			NO_2	.22	2	VI-16
			SO_2	.03	.5	VI-15
			CO	< .1	1.4	VI-16
		N48 T + 48T	TSP	43	.5	VI-15
			NO_2	.23	1.5	VI-16
			SO_2	.03	.5	VI-15
			CO	.1	1.5	VI-16
Oil Processing	Ventura	N48	NO_2	.10	8.0	VI-16
			SO_2	< .01	2.4	VI-16
		N48 + 48	NO_2	.16	8.2	VI-16
			SO_2	< .01	2.4	VI-16
Gas Processing	Ventura	N48	SO_2	.02	18.8	VI-16
			H_2S	[c]	--	--
			NO_2	.35[d]	10.9	VI-16
		N48 + 48	SO_2	.03	18.7	VI-16
			H_2S	.15	.5	VI-15
			NO_2	.54[d]	11.	VI-16

[a]See Table III.D.2.b-2 for nomenclature.
[b]Concentrations are given in $\mu g/m^3$ for TSP and ppm for all gaseous pollutants.
[c]No emissions.
[d]Values are greater than California ambient air quality standard.

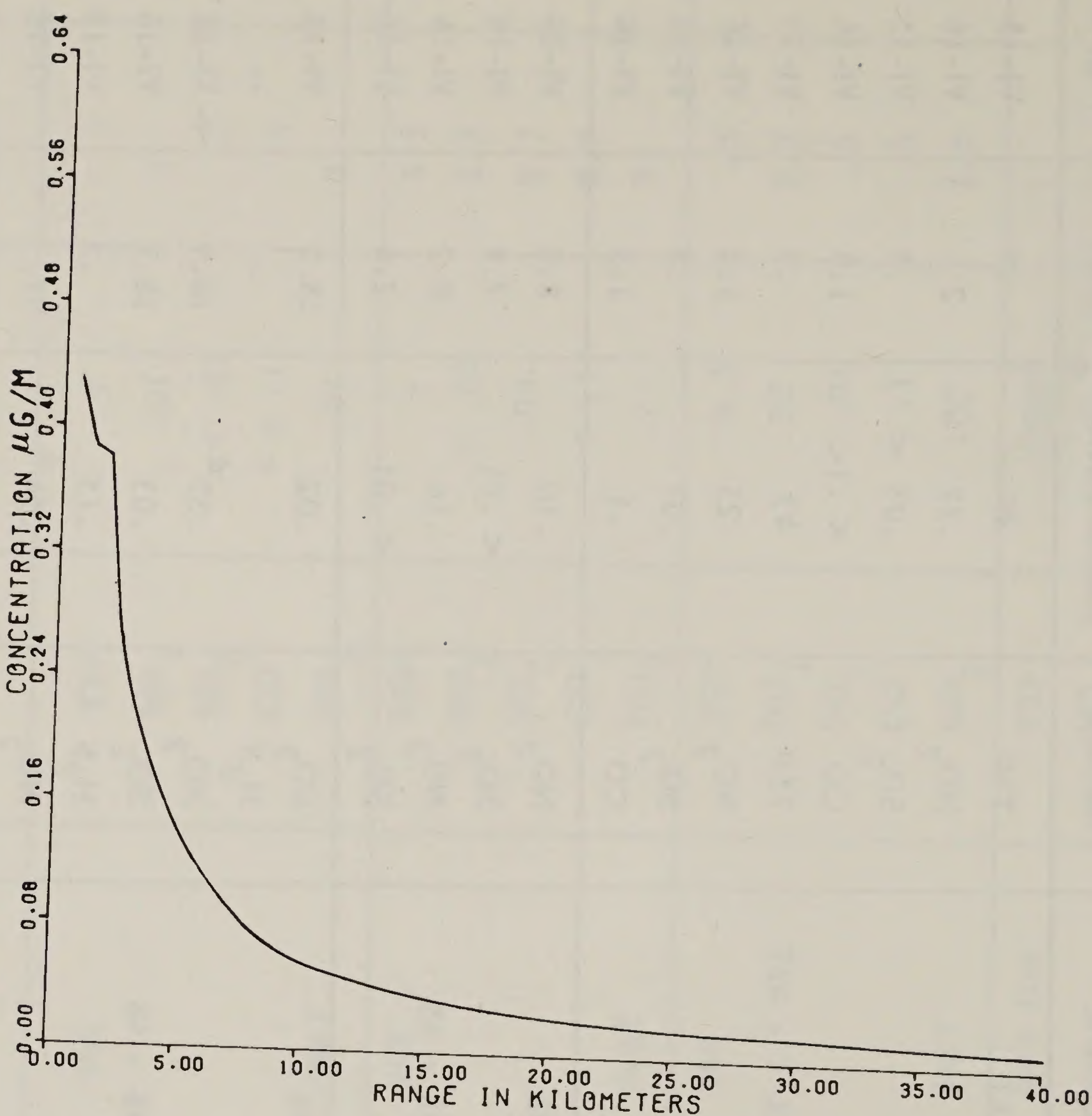


Figure III.D.2.c-1 Nature of the Downwind Profile of Ground-level Impacts from a Variety of Non-buoyant Surface-level Sources. The Concentration Scale is in Arbitrary Units

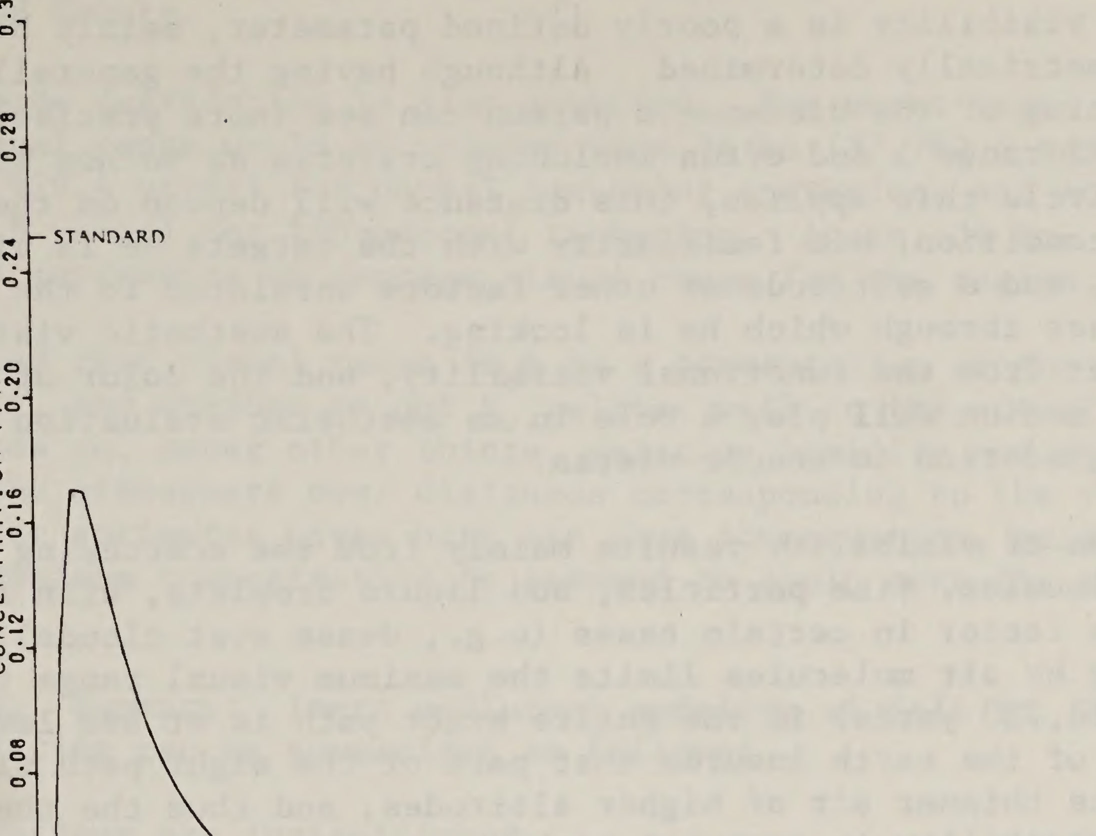


Figure III.D.2.c-2 Nature of the Downwind Profile of Ground-level Impacts from a Variety of Sources With Significant Buoyancy. The Concentration Scale Is In Arbitrary Units

fire, TSP, SO_2, and NO_2 concentrations, show significant 1-hour average impacts for quite some distance downwind. The maximum SO_2 and NO_2 impacts are both over their respective standards.

d. Visibility: Any discussion of visibility must first note that visibility is a poorly defined parameter, mainly because it is physiometrically determined. Although having the generally understood meaning of the distance a person can see (more precisely called the "visual range") and often including criteria as to how much of the horizon circle this applies, this distance will depend on the observer's physical condition, his familiarity with the targets he is viewing, the sun angle, and a multitude of other factors unrelated to the clarity of the air mass through which he is looking. The aesthetic visibility will also differ from the functional visibility, and the color of the obscuring medium will play a role in an aesthetic evaluation of visibility degradation to scenic vistas.

Degradation of visibility results mainly from the scattering of light by gas molecules, fine particles, and liquid droplets, with absorption of light a factor in certain cases (e.g., dense soot clouds). Rayleigh scattering by air molecules limits the maximum visual range to about 200 km (218,720 yards) if the entire sight path is at sea level. Curvature of the earth insures that part of the sight path will be through the thinner air of higher altitudes, and thus the theoretical limit to visibility is somewhat higher.

The visual impact of the projected OCS developments (aside from the aesthetic effect of structures) will occur from a general degradation of atmospheric clarity due to particulate matter emitted from the facilities or formed chemically from gaseous emissions. Because atmospheric aerosols tend to assume a self-preserving size distribution when far from a source, the relationship between atmospheric clarity and particulate mass concentration can be handled adequately by formulas such as those discussed by Tombach (1972). Recent papers in the literature have further refined the formulas summarized in the Tombach paper. All of these formulas assume certain physiometric properties of the eye, which can be adjusted depending on the nature of the desired visual range description. A complete discussion of the methodology used in calculating visual range is given in AeroVironment Report (1977).

In Region I, no significant visibility impact is forecast since no significant impact on particulate concentrations is expected from Sale No. 48.

In Region II, some degradation is expected. Assuming a worst-case situation, an observer is looking through the densest part of the

particulate plume, the visual range would be reduced from 18 km (19,684.8 yards) to 17.4 km for normal tankering operations under worst-case impacts and to 17.1 km (19,028.6 yards) for 100-percent tankering. The 18 km (19,684.8 yards) figure represents an average visual range for the area of maximum impact, approximately 4 km (4,374.4 yards) offshore of central Orange County.

In Region III, some degradation is also expected. For worst-case meteorology, visual range would be reduced from 34 km (37,182.4 yards) to 32.9 km (35, 979.4 yards) for normal tankering operations and to 29.4 km (32,151.8 yards) for 100-percent tankering. Again, 34 km (37,182.4 yards) represents an average visual range for the region.

It should be noted that visual range (L_v) is a presentation of the local air quality, and whether or not L_v relates well to the actual visibility depends on, among other things, relative humidity and the homogeneity of the atmosphere over distances corresponding to the visual range. The impact estimates given here are thus conservative, because the worst-case maximum concentration is assumed to apply over the entire sight path.

e. Summary: Inert pollutant modeling of Sale No. 48 with normal tankering can be summarized as follows:

CO concentrations are insignificant.

SO_2 concentrations are only a problem around the other major projects considered; Sale No. 48 itself has an insignificant impact on SO_2 concentrations.

NO_2 has two problem areas. Concentrations downwind from the gas and oil processing facilities for Sale Nos. 35 and 48 in Ventura exceed NO_2 standards.

Sale No. 48 increases the maximum 1-hour concentration from 0.47 ppm to 0.66 ppm, including background facility in Los Angeles also causes the maximum regional impact in its area, increasing the concentration from 0.30 ppm to 0.31 ppm. There would, however, not be an exceedance of the annual average standard. The exceedance in the Los Angeles area is due to background alone, so that the small impact from Sale No. 48 increases the exceedance. The offshore facilities have an insignificant impact on onshore concentrations.

TSP concentrations on land from Sale No. 48 facilities are very small. The other proposed major projects in the Ventura area cause exceedance of the TSP standards, but Sale No. 48 impact in this location is insignificant. Background concentrations of TSP

exceed short and long term standards, even out to the offshore facilities in the Los Angeles and Orange County areas; the small impact from Sale No. 48 in this offshore location increases the 24-hour average background of 130 $\mu g/m^3$ to 133 $\mu g/m^3$. The impact on onshore concentrations is insignificant.

H_2S centerline concentrations downwind from the gas processing facility in Ventura exceed State standards close to the emission source (within 2 km (2,187.2 yards). No other sources associated with Sale No. 48 release significant quantities of H_2S.

Inert pollutant modeling of Sale No. 48 with 100-percent tankering can be summarized as follows:

CO concentrations are insignificant.

SO_2 concentrations are insignificant.

NO_2 concentrations from Sale No. 48 have the largest impact offshore of Orange County where the concentration is increased from 0.18 ppm to 0.27 ppm. There would not be an exceedance of the annual average standard. The offshore facilities have an insignificant effect on concentrations onshore. The gas and oil processing facility does not exist for the 100-percent tankering scenario.

TSP impact is slightly larger but still very small for Sale No. 48 with 100-percent tankering. The 24-hour average concentration offshore of Los Angeles and Orange Counties is increased from 130 $\mu g/m^3$ to 134 $\mu g/m^3$ at the maximum impact location. The annual geometric mean of background TSP would be above the standard with or without Sale No. 48. The impact onshore is insignificant.

H_2S concentations from Sale No. 48 activities are insignificant.

Inert pollutant modeling of possible accidents associated with Sale No. 48 can be summarized as follows. The 1,000 bbl/d blowout with fire is the worst-case for CO, SO_2, NO_2, and TSP and without fire is the worst-case for H_2S.

CO concentrations are below standards even very near local sources. The regional modeling shows that the maximum impact locations, including background, are all within standards.

SO_2 concentrations are above standards in the plume downwind of the fire with a maximum at 1 km of 1.6 ppm. Impacts above the air quality standard are all located beyond 5.56 km (3 miles) from shore.

f. OCS Emissions and Attainment Plans: The Clean Air Act requires that states must have Attainment Plans approved by EPA by July, 1979 which show the strategies that result in sufficient emissions reductions in all non-attainment areas to ensure attainment of air quality standards by specified dates. The non-attainment areas in the study area are indicated in Section II.H.1.C. The Attainment Plans presently being finalized do not consider emissions associated with Sale No. 48. Thus, Sale No. 48 will be inconsistent with these plans. Because the emissions associated with Sale No. 48 are significant compared to various local county emissions, the local counties and planning agencies have expressed concern about the effect Sale No. 48 activities would have on their Attainment Plans. The Clean Air Act stipulates very significant penalties to any area which either does not have an approved plan by July, 1979, or does not reach attainment of air quality standards by the specified dates (1982 and 87). These penalities include refusal of all air quality permits in these areas and removal of monetary support from Federal highway and sewage programs.

If New Source Review (NSR) of all Sale No. 48 activities occurs, then the NSR process will ensure compliance with all Attainment Plans. Thus, it is expected that Sale No. 48 emissions affecting non-attainment areas would require offsets (emission reductions from other non-Sale No. 48 sources in addition to those required for attainment in the Attainment Plan) and all Class I areas would be protected. Thus, if NSR occurs, then the Sale No. 48 activities would have no impact on Attainment Plans or attainment and maintenance of air quality standards.

However, if NSR does not apply, then Sale No. 48 would affect Attainment Plans. The impacts from Sale No. 48 activities would have to be included in these plans in order for the affected non-attainment areas to reach attainment. The affected Attainment Plans approved by EPA would have to be revised to have provisions which include mitigating the impacts from Sale No. 48 activities. If these provisions are the ones required to mitigate the impacts from Sale No. 48 identified in this report, then Sale No. 48 will have only a small impact on the Attainment Plans since the air quality impacts are small compared to background and the ambient air quality standards. However, without additional provisions, Sale No. 48 impacts would result in slight delay in reaching attainment of air quality standards, and this may result in implementation of the federal sanctions stipulated in the Clean Air Act.

However, ozone non-attainment areas have an especially difficult problem because of the state-of-the-art of mathematical models available to analyze ozone impacts. The analysis presented in this Final EIS used a trajectory photochemical model (REM2) which quantified ozone impacts, and which showed a small ozone impact from Sale No. 48 activities. Other models which include transport and photochemistry could also be used for planning purposes.

NO_2 peak concentrations approach the standard downwind of the fire.

TSP plume centerline concentrations for 1-hour peak at 1,380 $\mu g/m^3$, well over the 24-hour standard of 100 $\mu g/m^3$ downwind of the fire. Meteorological changes (like wind direction) during the day will scatter the plume and reduce the 24-hour average concentration from the fire, but will still result in TSP concentrations above the standard.

H_2S concentrations associated with a blowout without fire in Santa Barbara Channel will have a maximum impact of 0.11 ppm - well above the State standard of 0.03 ppm. The impact is located close to the platform; concentrations will be within the standard by 10 km (10,936 yards) downwind.

In particular, the EPA recommends the EKMA model for urban photochemistry planning. Its application to the assessment of Sale No. 48 impacts must be performed cautiously, however, since the situation here is not the usual urban emissions configuration. Since the offshore Sale No. 48 emissions are geographically well removed from onshore emissions, these two groups of emissions cannot be aggregated to obtain the initial pollutant concentrations required for the EKMA calculation. If the plans approved by EPA were based on an application of the EKMA model with offshore Sale No. 48 emissions treated in aggregate with onshore emissions, rather than considering the spatial distribution of these emissions, then Sale No. 48 would have a significant impact on the Attainment Plan and thus would have a significant impact on the local populations which must implement these provisions. It should be stressed, however, that the ozone air quality impacts from Sale No. 48 identified in this Final EIS are in reality small because of the spatial distribution of the offshore emissions. Thus, it is important that the attainment plans be based on modeling which does consider the benefits of this spatial distribution of emissions.

3. Modeling of Photochemically Reactive Contaminants

a. Model Description and Inputs: The Pacific Environmental Services REM2 photochemical air quality simulation model was used to assess the impacts of the proposed Sale No. 48 oil leases on photochemical air pollution in Southern California. Ozone (O_3) and nitrogen oxides are photochemical pollutants that are determined with REM2. REM2 is a Lagrangian air quality model which uses a 34-reaction chemical mechanism to simulate photochemical pollutant concentrations. Because of the photochemically reactive nature of the pollutants, it is necessary to model these dynamic reactions in order to determine the concentrations of ozone. Worst-case analysis of NO_2 is discussed in Section 2. The model is described in detail in the AeroVironment Report (1977).

Validation runs of the REM2 model were made, using 1975 emission data bases, to test the accuracy of the model's predicted concentrations in three different locations: Santa Barbara, Los Angeles, and San Diego. The validation runs are described in more detail in the AeroVironment Report (1977). The REM2 model showed excellent agreement between predicted and observed concentrations for days with high photochemical pollutant concentrations in 1975.

Simulation runs using the REM2 model were made for the year 1986 to assess the photochemical air quality impacts of the proposed Sale No. 48 oil leases. Model runs were made for three main scenarios:

(1) Normal tankering emissions
(2) 100% tankering emissions
(3) Accidents

In each case, model runs were made with and without Sale No. 48 emissions in order to assess the incremental air quality impacts of Sale No. 48. Model trajectories were chosen which passed directly over Sale No. 48 emission sources during daylight hours, thus simulating the maximum air quality impacts of Sale No. 48.

Model Inputs

Emission-Grids. The REM2 model requires a gridded emission inventory of freeway traffic, street traffic, and point and area source emissions for the region of interest. Separate emission grids were used of the four major areas of interest:

(1) Santa Barbara - (Eschenroeder, et al, 1976).
(2) Ventura - (Barberio, 1977).
(3) Los Angeles - (Nordsieck, 1974).
(4) San Diego - (ARB Modeling Staff, 1977).

Emission estimates for offshore activities in 1975 and 1986 were allocated to an emissions grid covering the ocean off Southern California. All islands were allocated to the ocean grid and were assumed to have negligible emissions. Emissions north of Point Conception and south of the Mexican border were not considered.

Trajectories and Meteorology. The trajectories and meteorological conditions which were used for the 1975 validation runs and the 1986 simulations runs are described below. A detailed description of hourly trajectory position, mixing height, temperature, and relative humidity for each run is presented in the AeroVironment Report (1977). All model runs assumed zero cloud cover and a horizontal diffusion coefficient corresponding to neutral atmospheric stability.

Table III.D.3.a-1 is a tabulation of the trajectories used in each analysis including the trajectory designation and the figure illustrating the trajectory (Figures III.D.3.a-1 through III.D.3.a-8).

Initial Concentrations. The initial air quality concentrations for each run were derived, when possible, from measured air quality from a monitoring station near the trajectory starting point. The initial concentrations for all the validation runs were based on actual measured data from monitoring stations. For trajectories beginning in the ocean, initial concentrations were estimated from limited airborne data (Kauper, 1977) over the ocean and available data from monitoring sites on islands.

REM2 Validation Results. Validation runs of the REM2 model were made in three different locations, using the 1975 emission data bases, to test the accuracy of the model's predicted concentrations. Three days

Table III.D.3.a-1

TRAJECTORIES USED IN PHOTOCHEMICAL MODELING

Trajectory Designation	Figure
Validation Analysis	
SB	III.D.3.a-1
LA	III.D.3.a-1
SD	III.D.3.a-1
Regional Analysis	
SB1	III.D.3.a-2
SB3'	III.D.3.a-2
V2	III.D.3.a-3
V3	III.D.3.a-3
LA1	III.D.3.a-4
LA2	III.D.3.a-4
SD1	III.D.3.a-5
SD2	III.D.3.a-5
SM1	III.D.3.a-6
SD3'	III.D.3.a-6
Cumulative Analysis	
SM1	III.D.3.a-7
C1	III.D.3.a-7
C2	III.D.3.a-7
C3	III.D.3.a-7
Accident Analysis	
SB3'	III.D.3.a-8
LA1	III.D.3.a-8
SD3'	III.D.3.a-8
V1	III.D.3.a-8
TC	III.D.3.a-8

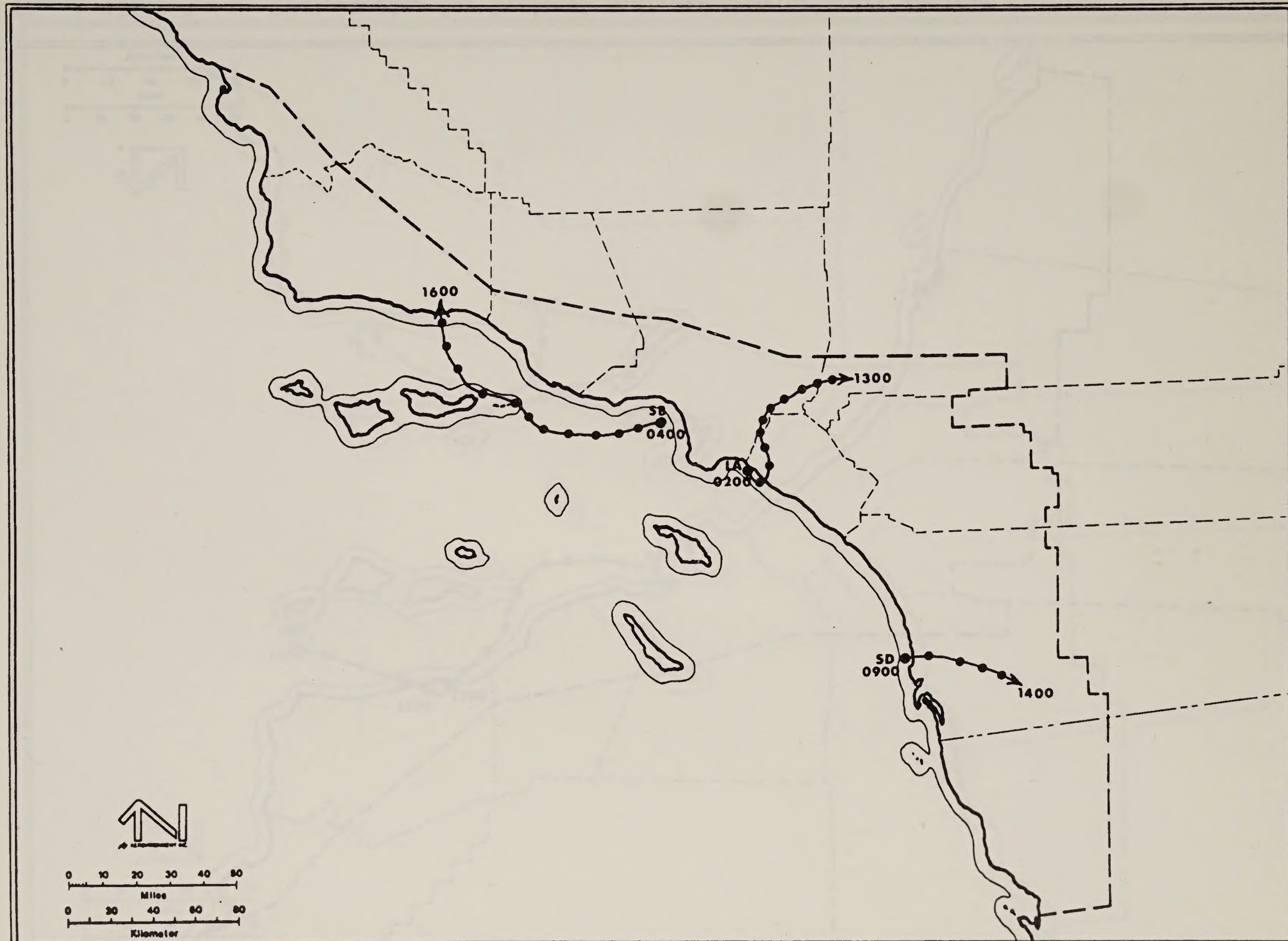


Figure III.D.3.a-1 Trajectories for Validation Analysis Showing Start and End Times

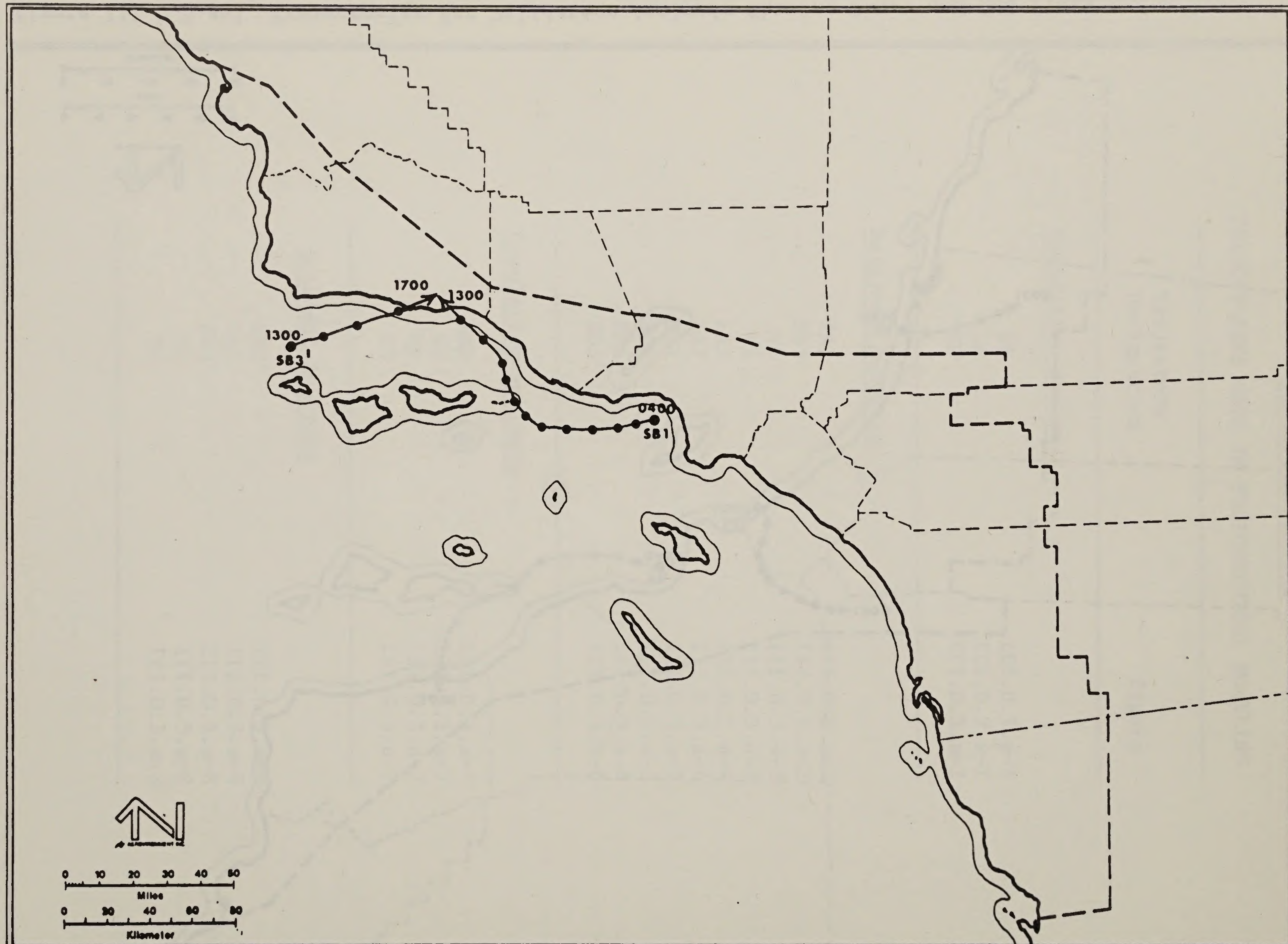


Figure III.D.3.a-2 Trajectories for Regional Analysis Showing Start and End Times

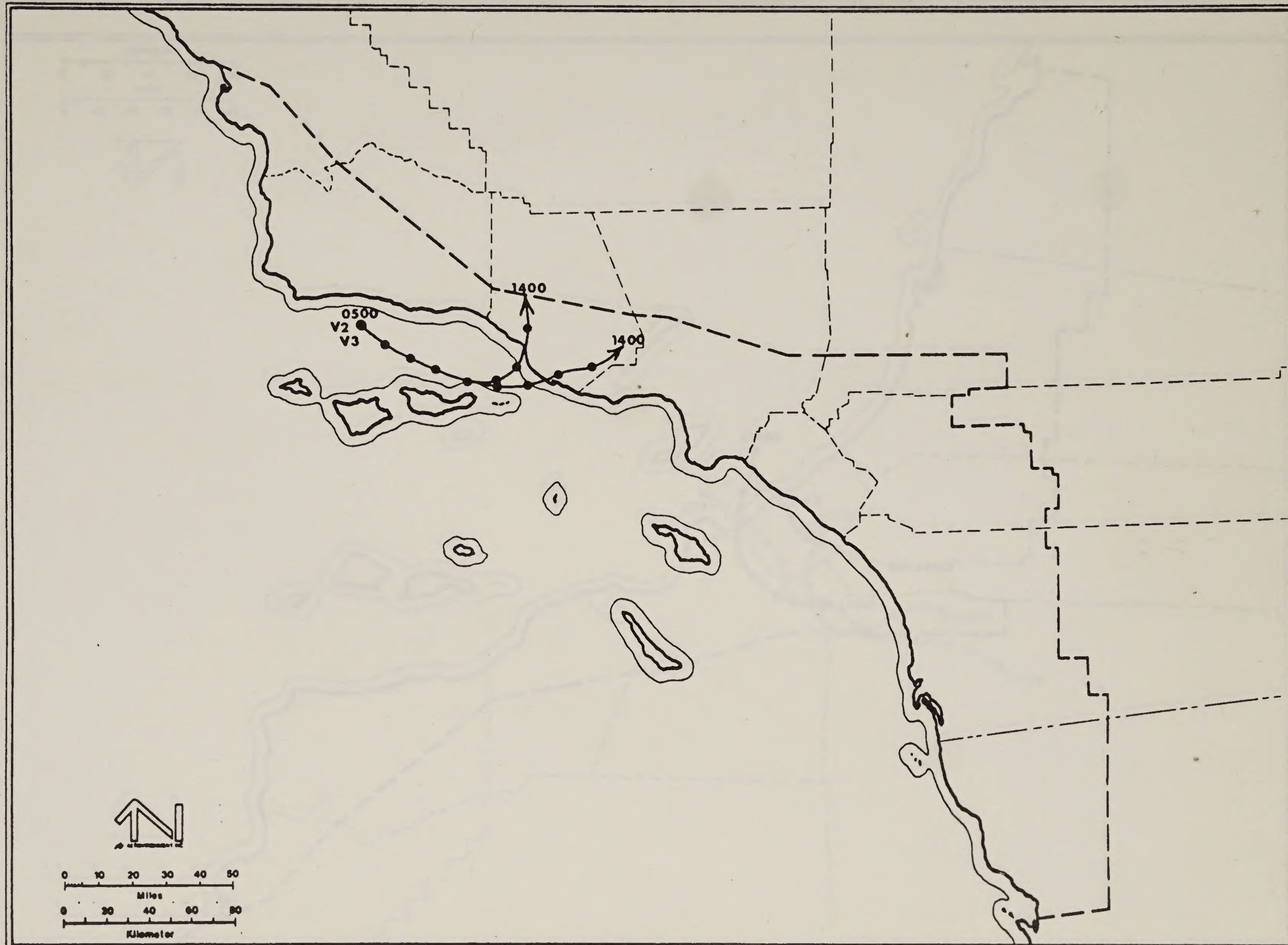


Figure III.D.3.a-3 Trajectories for Regional Analysis Showing Start and End Times

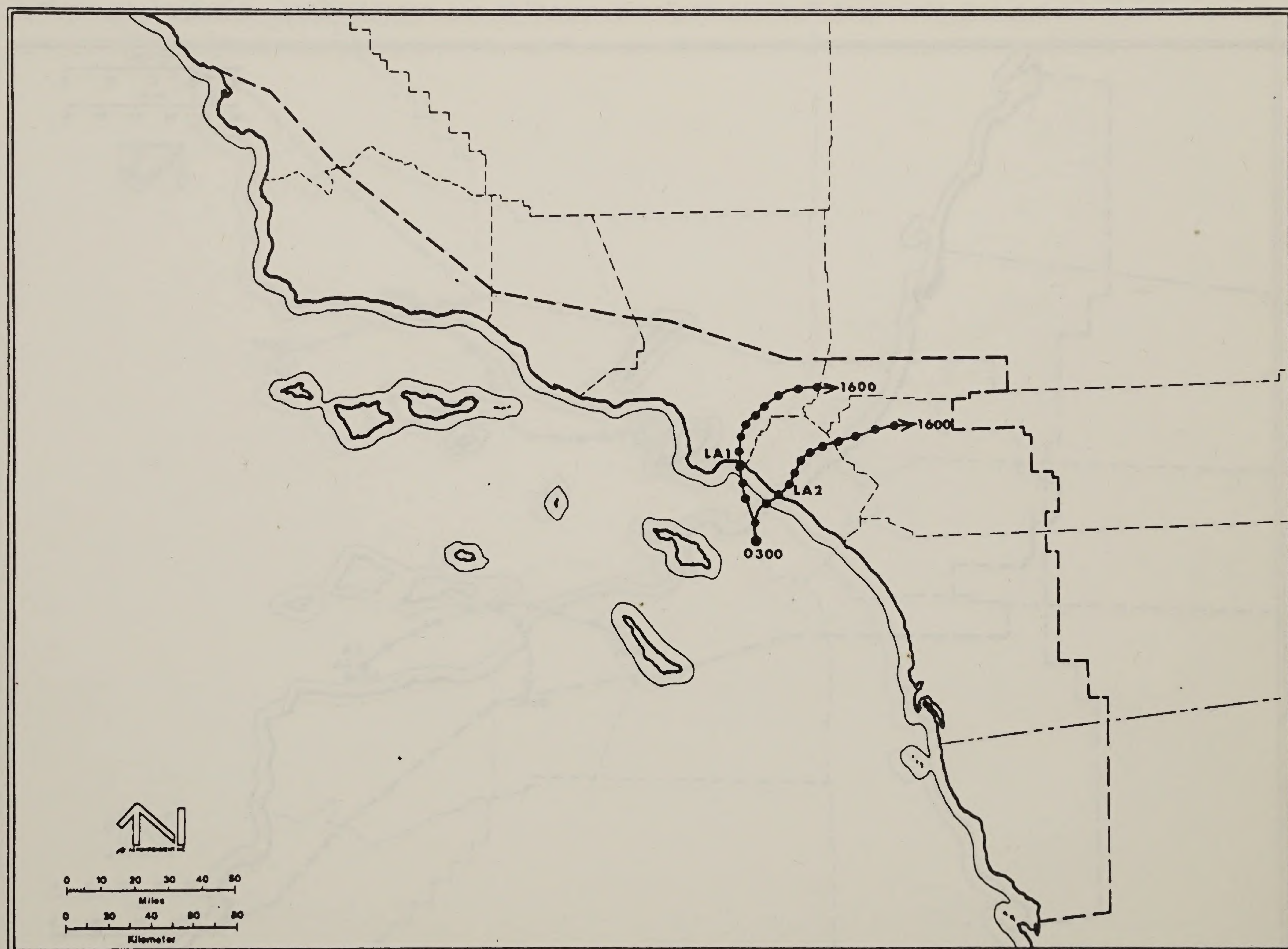


Figure III.D.3.a-4 Trajectories for Regional Analysis Showing Start and End Times

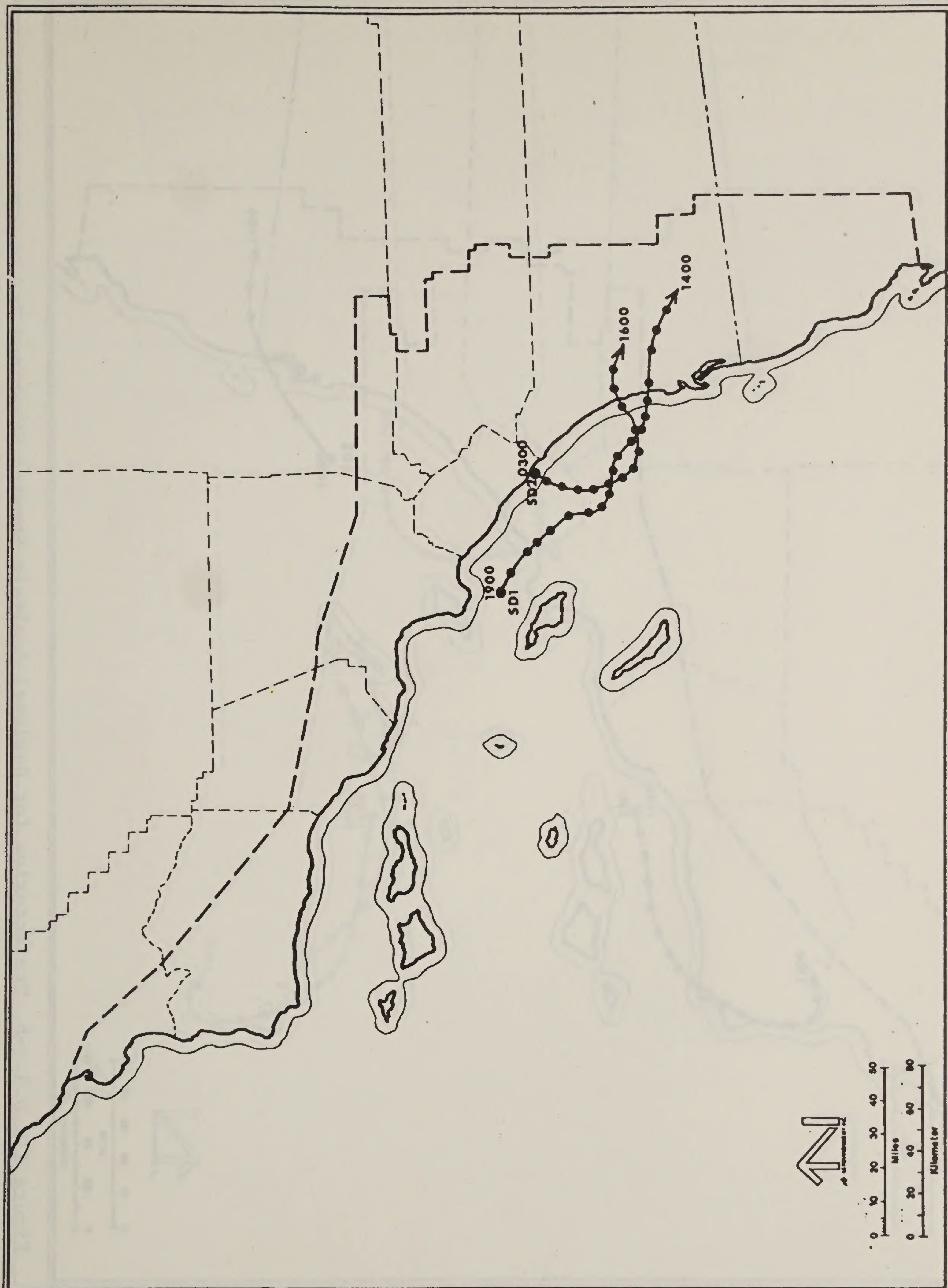


Figure III.D.3.a-5 Trajectories for Regional Analysis Showing Start and End Times

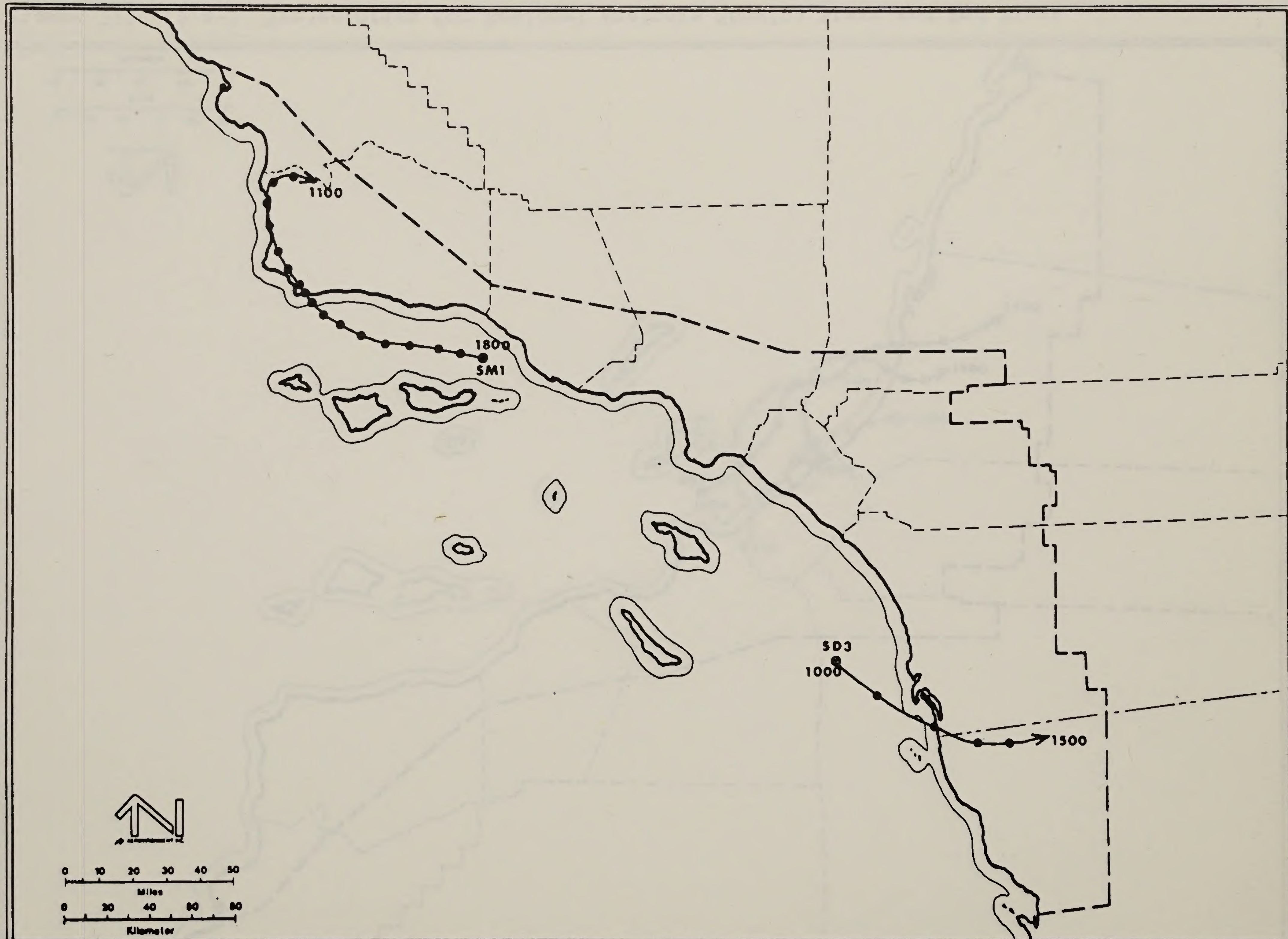


Figure III.D.3.a-6 Trajectories for Regional Analysis Showing Start and End Times

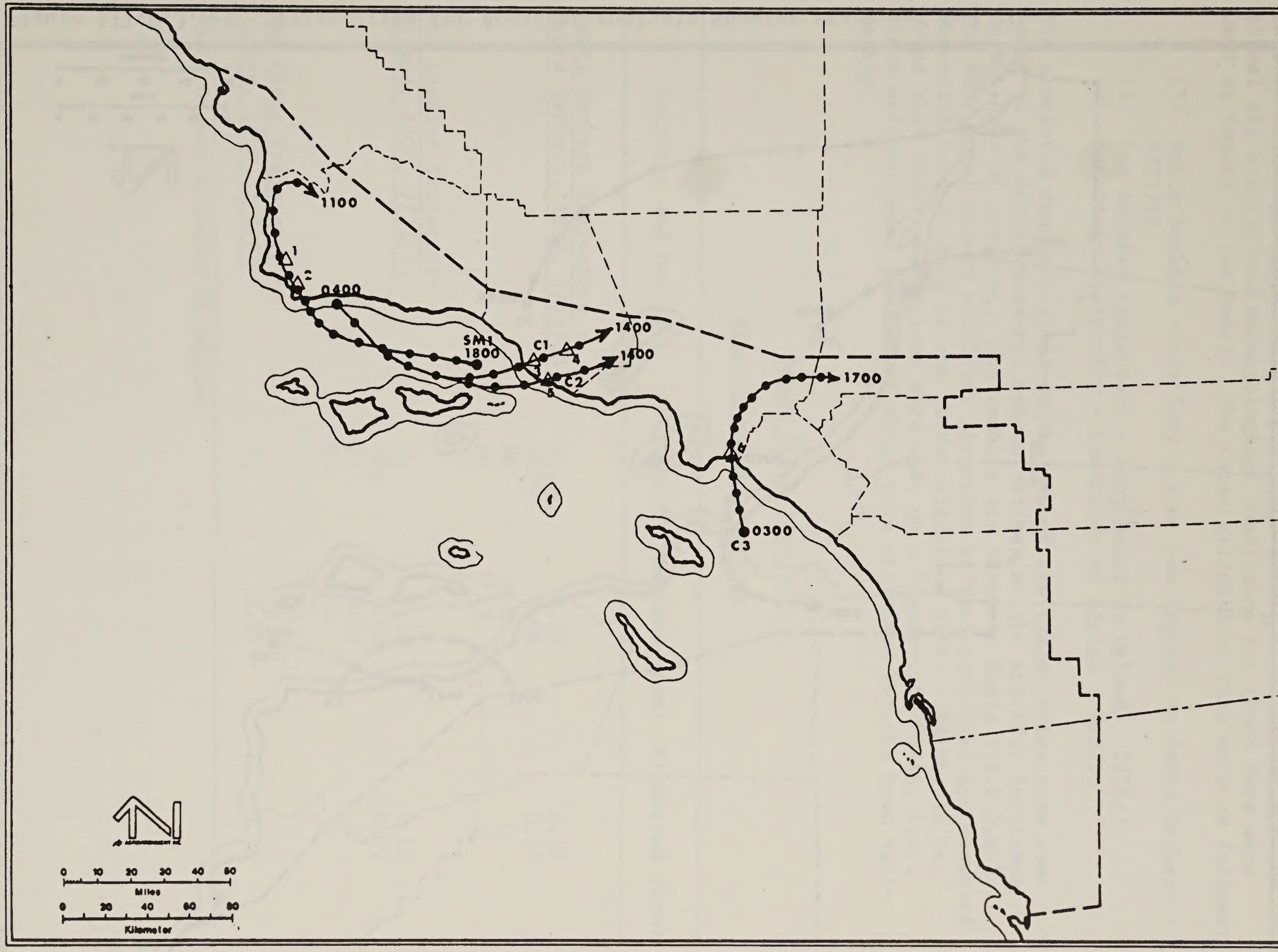


Figure III.D.3.a-7 Trajectories for Cumulative Analysis Showing Start and End Times

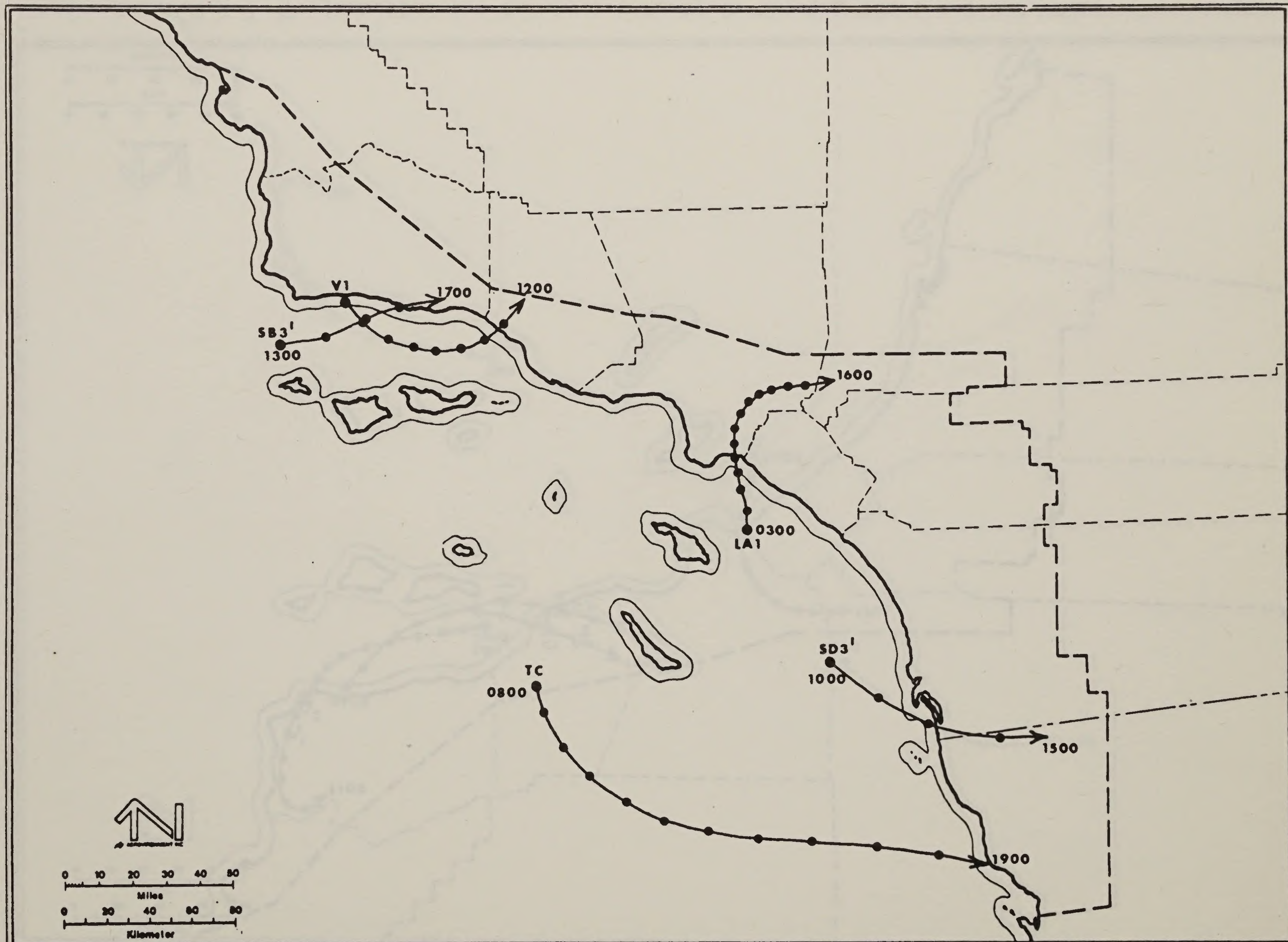


Figure III.D.3.a-8 Trajectories for Accident Analysis Showing Start and End Times

in 1975 with high photochemical pollutant levels were chosen; and the actual air quality and meteorological conditions for those days were used as inputs to the model. The three validations runs were as follows:

(1) Santa Barbara trajectory - West Los Angeles to Santa Barbara - 9/25/75
(2) Los Angeles trajectory - Long Beach to Upland - 7/25/75
(3) San Diego trajectory - Oceanside to Alpine - 9/3/75

The predicted concentrations at the end of the trajectories were compared to the actual measured concentrations at the specific locations on the days of interest. The results are shown in Table III.D.3.a-2. The REM2 model showed excellent agreement between predicted and observed concentrations at each of the three validation sites. It should be noted that these validations were made on a "hands-off" basis, i.e., there were no model parameters which were optimized for the best validation.

Table III.D.3.a-2

REM2 VALIDATION RESULTS

Location and Day	Pollutant[a]	Measured (ppm)	Predicted (ppm)
Santa Barbara Trajectory - Santa Barbara, 1600, 1/23/75	O_3	0.17	0.18
	NO_3	0.04	0.05
	NO	0	0
	CO	2	2
Los Angeles Trajectory - Upland, 1300, 7/25/75	O_3	0.32	0.25
	NO_2	0.08	0.09
	NO	0.01	0
	CO	4	3
San Diego Trajectory - Alpine, 1400, 9/3/75	O_3	0.19	0.16

[a]Only O_3 was measured at Alpine.

b. Simulation Results (1986) Normal Tankering Emissions

Assumptions. For the 1986 normal tankering simulations, REM2 model runs were made with and without Sale No. 48 emissions in order to assess the incremental air quality impacts of Sale No. 48. Model trajectories were chosen which passed directly over Sale No. 48 emission sources, thus simulating the maximum air quality impacts of Sale No. 48.

The normal tankering emission assumptions are discussed above. In the modeling runs, no tankers or barges were assumed to be loading at single buoy moors during the base case (without Sale No. 48). One tanker was assumed to be loading at a single buoy moor in the Santa Barbara Channel, one barge was assumed loading off Santa Barbara Island, and one barge was assumed to be loading off San Deigo during the model run with Sale No. 48. This approach maximized the impacts of the Sale No. 48 emissions. In the cumulative modeling runs, the fuel oil option for the Vaca Tar Sands facility was assumed.

Regional Results. Two different model runs were made in each of the four main areas of interest for the normal tankering emissions case:

(1) Santa Barbara (SB1, SB3)
(2) Ventura (V2, V3)
(3) Los Angeles (LA1, LA2)
(4) San Diego (SD1, SD2)

In addition, one run was made north of Point Conception (SM1) and south of the Mexican border (SD3). The model results for O_3 and NO_2 are summarized in Table III.D.3.b-1.

The normal tankering impacts of Sale No. 48 on photochemical air quality were extremely small, as shown in Table III.D.3.b-1. Typically predicted ozone levels were raised by only 0.001 ppm less. The greatest calculated impact was in the V2 trajectory, ending at Ojai, with an O_3 increase of 0.004 ppm, or roughly a 4 percent increase in the predicted O_3 level.

Cumulative Results. Four model runs were made to determine the cumulative air quality impact of Sale No. 48 normal tankering emissions and other proposed sources:

(1) LNG facility located at Point Conception site (SM1)
(2) LNG facility located at Oxnard site and Vaca Tar Sands facility (C1)
(3) Elk Hills facility (C2)
(4) SOHIO project (C3)

The space shuttle project was not estimated to produce any photochemically reactive pollutants and thus was not modeled. The model results for O_3 and NO_2 are summarized in Table III.D.3.b-2.

Table III.D.3.b-1

REGIONAL IMPACTS - NORMAL TANKERING EMISSIONS

Run	Case	O_3 (ppm)	NO_2 (ppm)
SB1	Without Sale 48	0.156	0.048
	With Sale 48	0.156	0.049
SB'	Without Sale 48	0.115	0.051
	With Sale 48	0.116	0.052
V2	Without Sale 48	0.099	0.031
	With Sale 48	0.103	0.034
V3	Without Sale 48	0.083	0.055
	With Sale 48	0.085	0.056
LA1	Without Sale 48	0.232	0.091
	With Sale 48	0.233	0.092
LA2	Without Sale 48	0.187	0.063
	With Sale 48	0.187	0.064
SD1	Without Sale 48	0.139	0.048
	With Sale 48	0.140	0.049
SD2	Without Sale 48	0.107	0.044
	With Sale 48	0.107	0.044
SM1	Without Sale 48	0.070	0.042
	With Sale 48	0.071	0.043
SD3'	Without Sale 48	0.123	0.041
	With Sale 48	0.124	0.041

Table III.D.3.b-2

CUMULATIVE IMPACTS - NORMAL TANKERING EMISSIONS

Run	Case	O_3 (ppm)	NO_2 (ppm)
SM1	Without Sale 48	0.070	0.043
	With Sale 48	0.070	0.044
C1	Without Sale 48	0.096	0.036
	With Sale 48	0.098	0.037
C2	Without Sale 48	0.095	0.032
	With Sale 48	0.097	0.033
C3	Without Sale 48	0.248	0.089
	With Sale 48	0.251	0.091

Again, the impacts of normal tankering Sale No. 48 emissions on photochemical air quality were extremely small, as shown in Table III.D.3.b-2. The greatest calculated impact was in the C3 trajectory, ending at Upland, with an O_3 increase of 0.003 ppm, or roughly a 19 percent in the predicted O_3 level. It should be noted that the results in Table III.D.3.b-2 show only the air quality impacts of Sale No. 48 emissions - the effects of the other proposed sources are included in both the cases considered.

c. Simulation Results (1986) - 100 Percent Tankering Emissions:

Assumptions. As in the normal tankering emission simulations, REM2 model runs were made with and without Sale No. 48 emissions, assuming 100 percent tankering, in order to assess the incremental air quality impacts of Sale No. 48. Model trajectories were chosen which passed directly over Sale No. 48 emissions sources, thus simulating the maximum air quality impacts of Sale No. 48.

The 100 percent tankering emission assumptions are discussed above. In the modeling runs, no tankers or barges were assumed to be loading at single buoy moors during the base case (without Sale No. 48). One barge was assumed to be loading off Santa Barbara Island, off San Pedro, and off San Diego, and one tanker and one barge were assumed to be loading at single buoy moors in the Santa Barbara Channel during the model runs

with Sale No. 48. This approach maximized the impacts of the Sale No. 48 emissions. In the cumulative modeling runs, the fuel oil option for the Vaca Tar Sands Facility was assumed.

Regional Results. Model runs were made in each of the four main areas of interest for the 100 percent tankering emissions case:

(1) Santa Barbara (SB1)
(2) Ventura (V2, V3)
(3) Los Angeles (LA1)
(4) San Diego (SD1)

Two different model runs were made in Ventura, since this was the region of the maximum air quality impacts of the normal tankering Sale No. 48 emissions. In addition, one run was made north of Point Conception (SM1) and south of the Mexican border (SD3'). The model results for O_3 and NO_2 are summarized in Table III.D.3.c-1.

Table III.D.3.c-1

REGIONAL IMPACTS - 100 PERCENT TANKERING EMISSIONS

Run	Case	O_3 (ppm)	NO_2 (ppm)
SBI	Without Sale 48	0.157	0.047
	With Sale 48	0.158	0.048
V2	Without Sale	0.089	0.029
	With Sale 48	0.093	0.030
V3	Without Sale 48	0.083	0.054
	With Sale 48	0.088	0.054
LA1	Without Sale 48	0.231	0.092
	With Sale 48	0.234	0.092
SD1	Without Sale 48	0.140	0.048
	With Sale 48	0.140	0.049
SM1	Without Sale 48	0.074	0.044
	With Sale 48	0.075	0.046
SD'	Without Sale 48	0.124	0.041
	With Sale 48	0.124	0.041

The 100 percent tankering impacts of Sale No. 48 on photochemical air quality were very small, as shown in Table III.D.3.c-1. The greatest calculated impact was in the V3 trajectory, ending in the Simi Valley, with an O_3 increase of 0.005 ppm, or roughly a 6 percent increase in the predicted O_3 level. In general, the O_3 and NO_2 air quality impacts of Sale No. 48 emissions were slightly higher in the 100 percent tankering emissions case than in the normal tankering emissions case.

Cumulative Results. Four model runs were made to determine the cumulative air quality impact of 100 percent tankering emissions and other proposed major emission sources:

(1) LNG facility at Point Conception (SM1)
(1) LNG facility at Oxnard and Vaca Tar Sands facility (C1)
(3) Elk Hills facility (C2)
(4) SOHIO project (C3)

The model results for O_3 and NO_2 are summarized in Table III.D.3.c-2.

Table III.D.3.c-2

CUMULATIVE IMPACTS - 100 PERCENT TANKERING EMISSIONS

Run	Case	O_3 (ppm)	NO_2 (ppm)
SM1	Without Sale 48	0.074	0.044
	With Sale 48	0.075	0.046
C1	Without Sale 48	0.095	0.035
	With Sale 48	0.100	0.035
C2	Without Sale 48	0.094	0.030
	With Sale 48	0.098	0.031
C3	Without Sale 48	0.247	0.090
	With Sale 48	0.250	0.089

Again, the impacts of Sale No. 48 100 percent tankering emissions were very small, as shown in Table III.D.3.c-2. The greatest calculated impact was in the C1 trajectory, ending in the Simi Valley, with an O_3 increase of 0.005 ppm, or roughly a 5 percent increase in the predicted O_3 level. It should again be noted that the results in Table III.D.3.c-2 show the air quality impacts of Sale No. 48 emissions when superimposed

on the base of air quality including the impacts of the individual proposed emission sources.

d. Simulation Results (1986) - Accidents

Assumptions. Model runs were made assuming four different types of accident scenarios.

(1) 140 barrels oil spill
(2) 10,000 barrel oil spill
(3) 1,000 barrel/day blowout
(4) 1,000 barrel/day blowout with fire

The assumptions used in calculating emissions from these accidents are detailed above. For the modeling runs, a 140-barrel oil spill and a 1,000 barrel/day blowout have identical maximum emission rates (only hydrocarbons), and, thus, only one model run was necessary to determine the impact of both types of accidents. For the 1,000 barrel/day blowout fire, it was assumed in the modeling that the hot gases did not penetrate the mixing layer, i.e., all emissions were trapped below the mixing layer.

Simulations were made for a base case (without Sale No. 48 emissions) and with Sale No. 48 emissions and the different accident emissions. Model trajectories were chosen which passed directly over the accident sites, thus simulating the maximum air quality impacts of the accidents. For the oil spills, emissions during the first hour of evaporation were used in the modeling runs.

Results. REM2 model runs were made to assess the impact of accidents on air quality in the following areas:

(1) Santa Barbara (accident site in Santa Barbara Channel - SB3' trajectory)
(2) Los Angeles (accident site off San Pedro - LA1 trajectory)
(3) San Diego (accident site off San Diego - SD3' trajectory)
(4) Ventura (accident site in Santa Barbara Channel - V1 trajectory)
(5) Mexico (accident iste in Tanner/Cortez Banks - TC trajectory)

For the Ventura and Mexico impacts, only the 10,000 barrel oil spill accident was modeled. The model results for O_3 and NO_2 are summarized in Table III.D.3.d-1.

As shown in Table III.D.3.d-1, the predicted air quality impacts were relatively minor for three types of accidents - the 140-barrel oil spill, the 1,000 barrel/day blowout, and the 1,000 barrel/day blowout with fire. However, the large 10,000 barrel oil spill produced significant effects. Increases in maximum O_3 levels resulting for the worst hour of emissions due to a 10,000 barrel oil spill ranged from 0.069 ppm in Santa Barbara

to 0.149 ppm in Los Angeles (Upland). Emissions from other hours would result in concentrations which have less impact. Since the Federal 1-hour averaged standard for O_3 is 0.08 ppm, a 10,000 barrel oil spill was predicted to cause increases in O_3 levels which exceeded the Federal standard in Los Angeles, San Diego, and Ventura.

Table III.D.3.d-1

REGIONAL IMPACTS - ACCIDENTS

Run	Case	O_3 (ppm)	NO_2 (ppm)
SB3'	Base case (without Sale 48)	0.115	0.051
	1,000 bbl/day blowout with fire	0.115	0.053
	140 bbl spill or 1,000 bbl/day blowout	0.118	0.052
	10,000 bbl spill	0.184	0.038
LA1	Base case (without Sale 48)	0.232	0.091
	1,000 bbl/day blowout with fire	0.235	0.093
	140 bbl spill or 1,000 bbl/day blowout	0.239	0.091
	10,000 bbl spill	0.381	0.055
SD3'	Base case (without Sale 48)	0.123	0.041
	1,000 bbl/day blowout with fire	0.124	0.041
	140 bbl spill or 1,000 bbl/day blowout	0.126	0.041
	10,000 bbl spill	0.203	0.028
V1	Base case (without Sale 48)	0.064	0.024
	10,000 bbl spill	0.152	0.009
TC	Base case (without Sale 48)	0.064	0.011
	10,000 bbl spill	0.141	0.004

e. Impact of Lease Sale No. 48 on PSD Class I Areas: As mentioned previously in Section II.H.l.c, there are, at present, no PSD Class I areas which would be significantly impacted by lease Sale No. 48 emissions. There is one proposed Class I area, however, the Channel Islands National Monument, which could be impacted by such emissions. The worst-case air quality impact of proposed lease Sale No. 48 has been estimated for Anacapa, Santa Barbara, and San Miguel Islands, and these impacts compared with the allowable PSD Class I increments. An analysis was conducted to determine the maximum 1-hour concentrations of both particulate matter and sulfur dioxide onshore of each of the three islands resulting from the operation of both a representative drilling platform and a representative SBM. Such analysis assumed that the platform or SBM was located on a Sale No. 48 tract, at least beyond the 3-mile limit, and in such a manner as to cause the maximum onshore concentrations of both pollutants. The results of this analysis has been presented in Table III.D.3.e-1. It should be noted that the values in Table III.D.3.e-1 are a conservative estimate of one-hour concentrations compared with a 3-hour and/or 24-hour standard. During Santa Ana winds, which can be present for more than 24 consecutive hours, it is likely that the allowable Class I increments could be exceeded (or at least consumed) depending upon placement of the emission source(s).

The above analysis assumes that the location of either a platform or SBM is such as to cause the maximum impact. The largest impact is from SO_2 emissions from tankers loading at SBM's. As shown in Figure III.D.2.c-2, downwind centerline concentrations decrease rapidly after the peak concentration. Thus, the precise location of these facilities is of critical importance. The location of SBM's in Santa Barbara Channel are expected only northwest of San Miguel Island. Thus, the SBM's impact on Anacapa Island should be minimal. Due to the geology of the Santa Barbara Channel, it is likely that the platforms and SBM's will be placed generally parallel with the Channel Islands and, thus, would not be in line with the Santa Ana winds. Such placement would tend to reduce significantly the combined onshore concentrations resulting from emissions from all platforms and SBM's.

Another factor must, also, be taken into consideration when looking at potential impacts. New Source Review, conducted by the appropriate regulatory agency, would analyze the impact from each platform and SBM on a case-by-case basis. By so doing, the reviewing authority would preclude any source from locating in an area so as to violate the applicable Class I increment. Thus, if New Source Review occurs, the impacts from the actual facilities associated with Sale No. 48 will be within all standards.

It is presently unclear whether the PSD requirements of the Clean Air Act are applicable for offshore emissions in OCS waters. This analysis is presented to determine the impact of Sale No. 48, if the PSD requirements apply.

Visual Impacts. With the exception of flaming offshore spills (a transitory event), there are no predicted visual impacts for any of the assumed scenarios over the Class I area.

Table III.D.3.e-1

MAXIMUM 1-HOUR IMPACT OF A REPRESENTATIVE PLATFORM AND SBM
RELATIVE TO THE ALLOWABLE PSD CLASS I INCREMENTS

		Worst Case 1-Hr. Impact		Allowable PSD Increments		
		Particulate Matter	Sulfur Dioxide	Particulate Matter	Sulfur Dioxide	
Island Name	Source Type	($\mu g/m^3$)	($\mu g/m^3$)	24-hour	3-hour	24-hour
Anacapa	Platform	16.7	13.3	10	25	5
Santa Barbara	Platform	16.7	13.3	10	25	5
	SBM	2.1	11.1	10	25	5
San Miguel	Platform	8.7	6.9	10	25	5
	SBM	4.0	78.6	10	25	5

4. Conclusions Based On Air Quality Impact Analysis

a. Conclusions Offshore: Offshore air quality impacts resulting from platform emissions are well under the appropriate standard (Figure III.D.2.C-1 and 2) as are all concentrations resulting from tanker loadings at SBM's. An accident with fire, however, shows significant TSP, SO_2 and NO_2 concentrations over the 1-hour average standard offshore.

b. Conclusions Onshore:

This section presents a summary of the impacts on air quality from Sale No. 48. The impacts are discussed, in order, for Santa Barbara and Ventura Counties, Los Angeles and Orange Counties, San Diego County, and other affected areas for each scenario analyzed. Inert and photochemical contaminants analyses results are summarized and compared to standards. The State and Federal ambient air quality standards are set to protect public health and welfare. The impacts are too small to quantify any health impacts. Major emission sources are identified.

It should be emphasized that impacts were determined: 1) for the peak production year of 1986 when emissions should be greatest, and 2) when meteorological conditions should maximize impacts. Thus, other years and other times during 1986 will have smaller impacts than those discussed below.

Santa Barbara and Ventura Counties

Photochemically Reactive Contaminants

Regional Impacts: The model results indicate that the emissions resulting from the addition of Sale No. 48 would increase the peak O_3 concentration by 0.001 ppm or less which is about 1 percent of the standard, for all trajectories analyzed for Santa Barbara County, for both normal and 100-percent tankering scenarios which is about 6 percent of the standard. The increase is 0.005 ppm or less for the Ventura County trajectories for both normal and 100-percent tankering scenarios. The peak O_3 concentrations predicted by the model are above the 1-hour Federal oxidant standard of 0.08 ppm for trajectories into Santa Barbara and Ventura Counties and slightly below the standard for the Santa Maria trajectory into northern Santa Barbara County for both tankering scenarios. In general, the impacts are slightly higher for the 100-percent tankering scenario than for the normal tankering scenario.

Although the exceedance of the O_3 standard would have occurred without Sale No. 48, this sale does increase the resulting peak O_3 concentrations and could delay the attainment of the Federal standards, although this effect may not be measurable in Santa Barbara County. There were no emission offsets identified and none were modeled.

Cumulative Impacts With Other Major Projects: The model results indicate that Sale No. 48 increases peak O_3 concentrations by 0.002 ppm or less for normal tankering and by 0.005 ppm or less for 100-percent tankering over the values which would occur if all other proposed projects took place. The peak O_3 concentrations are close to and above the Federal 1-hour standard of 0.08 ppm. Thus, although the increase is small, Sale No. 48 could slightly delay the attainment of the Federal standard.

Accident Impacts: The model results indicate a significant peak O_3 concentration impact potential from the accidents analyzed. The smaller spill and blowouts would cause less than 0.003 ppm increase. The larger 10,000 bbl spill could cause a 0.07 to 0.09 ppm increase in O_3 concentration at worst, resulting in peak 1-hour values varying from 0.18 ppm to 0.15 ppm depending on the trajectory. These values are over the Federal 1-hour standard.

Inert Contaminants

Regional Impacts: The regional impacts of Sale No. 48 are generally insignificant and the maximum impacts are located greater than 3 miles from shore except for the impacts of the gas and oil processing facilities onshore in Ventura. The analysis assumes that all oil and gas processing associated with both Sale No. 35 and Sale No. 48 with normal tankering is done at a single location. The modeling of the emissions from this processing predicts exceedances of the NO_2 1-hour California standard of 0.25 ppm and the Federal NO_2 annual average standard of 0.05 ppm in the Ventura area.

The maximum 1-hour NO_2 concentration predicted by the regional model was 0.66 ppm. When 100-percent tankering is assumed, and thus no processing is done in Ventura, the impact of Sale No. 48 is very small and located beyond 3 miles from shore. The scenario which includes Sale No. 48 with 100-percent tankering plus the other major projects, results in exceedances of the NO_2 1-hour standards, but the contribution from Sale No. 48 activities at the location of the maximum is insignificant (<0.01 ppm).

The regional CO, TSP, and SO_2 impacts of the normal operation of Sale No. 48 are insignificant (less than 10 percent of the inspection standards) and occur beyond 3 miles from shore; the 100-percent tankering scenario has slightly larger impacts than the normal tankering. The scenarios with the other major projects show significant SO_2 impacts onshore, but the impacts are from the other major projects (mainly Vaca Tar Sands and Elk Hills projects) and not associated with Sale No. 48. The Sale No. 48 activities have an insignificant additional impact with either normal or 100-percent tankering.

The impact of offshore platforms and SBM's associated with Sale No. 48 could cause an exceedance of the PSD Class I increment in the potential Class I areas of the Channel Islands. Proper siting could mitigate this impact (which NSR would ensure).

Accidents result in TSP and H_2S impacts located beyond 3 miles from shore.

Impacts of Specific Sources: The maximum downwind impacts from the various sources associated with Sale No. 48 in Santa Barbara and Ventura Counties were analyzed. There were significant impacts of NO_2 and H_2S from the gas and oil processing facilities in Ventura. The model indicated that the plume centerline NO_2 impact at the surface would be above the 1-hour standard over a broad range from 5 to 35 km (3.1 to 21.7 miles) downwind. Plume centerline H_2S concentrations peak at 0.15 ppm, decrease very rapidly, and are within standards by 2 km (1.2 miles) from the source. These results are very conservative (i.e., very high) because of the assumption that all oil and gas processing is done at a single location in Ventura and that all NO_x emissions are NO_2. In addition, the SBM's in the Santa Barbara Channel will also result in levels of TSP and NO_2 over the standards close to the emission source. However, the concentrations decrease rapidly with distance so that by 2 km (1.2 miles) downwind, the concentrations of the pollutants are all within standards. Thus, the impacts on the populated areas onshore are insignificant.

Accidents result in significant impacts for TSP, NO_2, SO_2 and H_2S. A blowout with fire results in peak 1-hour concentrations, excluding background, of TSP, NO_2 and SO_2 of 1,380 $\mu g/m^3$, 0.25 ppm and 1.64 ppm respectively. The NO_2 and SO_2 values are at and above 1-hour standards and the TSP level will lead to exceedance of the 24-hour standard of 100 $\mu g/m^3$. The blowout without fire results in a 1-hour peak H_2S concentration of 0.11 ppm - well over the standard of 0.03 ppm. These accident impacts are valid for all regions.

Los Angeles and Orange Counties

Photochemically Reactive Contaminants

Regional Impacts: The modeling results indicate that the emissions resulting from the addition of Sale No. 48 will increase peak O_3 concentrations by 0.001 ppm or less for normal tankering and 0.003 ppm for 100-percent tankering. The peak O_3 concentrations are 0.187 ppm to about 0.233 ppm, significantly above the Federal 1-hour standard of 0.08 ppm with or without Sale No. 48. Both scenarios have a small but adverse impact, which may not be measurable on attaining the Federal 1-hour standard. There were no emission offsets identified, and none were modeled.

Cumulative Impacts With Other Major Projects: The model results indicate that Sale No. 48 would increase peak O_3 concentrations by 0.003 ppm. The peak O_3 concentration is about 0.25

ppm with or without Sale No. 48, but Sale No. 48 will have a small adverse impact on attainment of the Federal 1-hour standard. This delay may not be measurable since Sale No. 48 causes less than 1 percent of the O_3 concentration which would have occurred without Sale No. 48.

Accident Impacts: The modeling predicts a significant impact potential on peak O_3 concentrations for the accidents analyzed. The blowout and smaller spills analyzed result in about a 1-percent increase to about 0.24 ppm in peak O_3 concentrations. The larger 10,000 bbl spill can cause a significant increase in peak O_3 concentration from 0.23 ppm without the accident to 0.38 ppm with the accident, which results in a change from a stage I (0.2 ppm) episode to a stage II (0.35 ppm) episode as defined by the California Air Resources Board. (SCAQMD, 1977).

Inert Pollutants

Regional Impacts: Maximum background concentrations for TSP and NO_2 exceed standards throughout the shore area, as well as offshore for TSP. Thus, any impact from Sale No. 48 will be to increase the degree of standard exceedance for these pollutants. For TSP, all maximum impact locations from Sale No. 48 are located beyond 3 miles from shore. The maximum 24-hour background concentration (without Sale No. 48) is predicted to be greater than the standard, with the impact of Sale No. 48 increasing the 24-hour average exceedance by 2 to 3 $\mu g/m^3$ - well offshore. The impact of Sale No. 48 TSP emissions at onshore locations is very small.

Under the normal tankering scenario, gas processing activities onshore would increase 1-hour nitrogen dioxide concentrations by 0.01 ppm, from 0.30 ppm to 0.31 ppm, in the regional scale. Exceedance of the annual standard is not anticipated, however. The impact from Sale No. 48 on CO and SO_2 concentrations is insignificant.

Impacts of Specific Sources: The platforms and SBM's are well offshore and their impacts peak within 2 km (1.2 miles) of the source. All pollutant maximums for platforms and SBM's are well under applicable standards.

The gas and oil processing facility in Los Angeles County would cause maximum NO_2 impacts approaching the 1-hour standard without Sale No. 48 or background included. Sale No. 48 increases the NO_2 maximum by 0.02 ppm. Sale No. 48 increases the maximum 1-hour TSP concentration by 5 $\mu g/m^3$, from 48 $\mu g/m^3$ to 53 $\mu g/m^3$, without background included.

Maximum concentrations of pollutants from a blowout with fire, which is a worst case for inert pollutants, are the same as for Santa Barbara and Ventura Counties.

Visibility: The visual range will decrease in the area of maximum impact from a normal range of 18 km (11.2 miles) offshore to a visual range of 17.4 km (10.8 miles) for normal tankering and to 17.1 km (10.6 miles) for 100-percent tankering. In the Tanner/Cortes field, the visual range will decrease from a normal value of 34 km to 32.9 km (21.1 to 20.4 miles) with normal tankering and to 29.4 km (18.3 miles) with 100-percent tankering. Sale No. 48 should have an insignificant impact on the maintenance of the State visibility standard.

San Diego County

Photochemically Reactive Contaminants

Regional Impacts: Emissions resulting from Sale No. 48 increase peak O_3 concentrations by 0.001 ppm or less for both normal and 100-percent tankering scenarios. The peak O_3 concentrations are expected to reach about 0.14 ppm with or without Sale No. 48, which is above the Federal 1-hour standard.

Cumulative Impacts With Other Major Projects: Since the additional other major projects included in the cumulative impact analysis are all located well outside of San Diego County, there is no difference between the regional impacts above and the cumulative impacts.

Accident Impacts: The model results indicate a significant impact potential on peak O_3 concentration from the accidents analyzed. The blowouts and smaller spills analyzed result in about 0.003 ppm or a 3-percent increase in peak O_3 concentrations. The larger 10,000 bbl spills can cause a significant increase in the peak O_3 concentration from 0.12 ppm without the spill to 0.20 ppm with the spill.

Inert Contaminants

Regional Impacts: Sale No. 48 impacts in San Diego County are located more than 3 miles offshore, where background concentrations of contaminants are below standards. The regional impacts are generally small and are within Federal and State standards. The emissions of Sale No. 48 have an insignificant impact on the shore in the San Diego area.

Impact of Specific Sources: The platforms and SBM's are well offshore and their impacts peak within 2 km (1.2 miles) of the source. All pollutant maximum concentrations from platforms and SBM's are well under applicable standards.

The peak concentration from blowout with fire, which is the worst-case condition for inert pollutants, is the same as for Santa Barbara and Ventura Counties.

Visibility: The visual range offshore will decrease from a normal value of 18 km (11.2 miles) in the area of maximum Sale No. 48 impact to a value of 17.4 km (10.8 miles) for normal tankering and to 17.1 (10.6 miles) for 100-percent tankering. Sale No. 48 should have an insignificant impact on the maintenance of the State visibility standard.

Other Affected Areas

The other affected area is the part of the study area south of the U.S.-Mexico border. The area north of Point Conception was discussed as part of Santa Barbara County.

Photochemically Reactive Contaminants

Regional Impacts: The model results indicate that the emissions from Sale No. 48 with either tankering scenario will increase the peak O_3 concentration just south of the border by less than 0.001 ppm from the level (0.124 ppm) it would be without Sale No. 48, which represents an unmeasurable impact.

Cumulative Impact with Other Major Projects: The other major projects are all located far enough north not to have any impact south of the border.

Accident Impacts: The model results indicate a significant impact potential on peak O_3 concentrations south of the border from the accidents analyzed. The large 10,000 bbl spill can cause a significant increase in peak O_3 concentrations if the contaminants are carried south of the border. The impact results in an increase in peak O_3 concentration from 0.06 ppm to 0.14 ppm which is over the U.S. standard of 0.08 ppm.

Inert Contaminants

Regional Impacts: Sale No. 48 will not have significant inert pollutant impact on areas south of the U.S.-Mexico border.

Impacts of Specific Sources: The maximum concentrations during normal operation will be insignificant by the time the plume has traveled south of the U.S.-Mexico border.

The accident scenario of a blowout with fire, the concentration in Mexico will be over a factor of 10 less than the peak centerline impact discussed for Santa Barbara County. Thus, the concentrations of the contaminants will be within both U.S. and California standards by the time they are carried to Mexico.

c. Conclusions About Attainment Plans:

Sale No. 48 will have only a small impact on the Attainment Plans since the air quality impacts are small compared to background and the ambient air quality standards. However, without additional provisions, Sale No. 48 impacts would result in slight delay in reaching attainment of air quality standards, and this may result in implementation of the federal sanctions stipulated in the Clean Air Act.

E. <u>Impacts of the Proposal - Onshore</u>

1. Impact on Shorelines: This section discusses, in general terms, the resultant activities and physical effects which may occur at the shoreline as a result of this proposal. Detailed discussion of the effects on specific resources occurs in the respective sections following.

Shorelines are the areas covered and uncovered by ebb and flow of waves and tides; and include the immediate backshore or cliff behind the wave-washed zone. In Southern California, much of the shoreline has been altered and consists of piers, jetties, breakwaters, wharves, and even homes. Those shorelines which are not structures, consist of unconsolidated materials like mud, sand, gravel, cobbles, or consolidated rock and are seldom static but are zones of active degradation, aggradation, or dynamic equilibrium. Rocky cliffs are erosive at a geologic rate which may reach several centimeters per year in some cases, while being measured in millimeters in the case of resistant outcrops. Unconsolidated shore sediments are readily permeable, thus, wave- and tidal-borne materials can easily find access to their deeper layers. Additional to solid shorelines are the entrances to bays, marshes, sloughs, and lagoons which may or may not communicate freely with the open ocean waters.

From the "Mixed A transportation" scenario (Table 4B in POCS Reference Paper No. VI), the probability of a spill of 1,000 bbl or more occurring from this proposal and reaching land within 10 days is 0.92 with a most likely number of spills equalling 2. For land impact within 60 days, the most likely number of spills is 3 and the probability is 0.98. Ten spills are most likely to occur from the combination of proposed and existing leases, reaching shore within 60 days and with a probability exceeding 0.995. It is thus statistically certain that several large spills resulting from this proposal will occur and contact shorelines.

Impacts occurring as a result of this proposed sale will arise from contamination and construction. Contamination will come from oil spills and possible alteration of nearshore water quality from offshore and coastal wastewater discharges. Construction of piers, jetties, pipelines, support, and separation facilities may take place.

Depending on oceanographic and meteorologic conditions as well as distance from the source to shore, sandy beaches could receive floating oil, along with dissolved and volatilized fractions. Floating oil could catch in kelp beds, mix with the surf, and be stranded all along the wet sand and mud flats to the highest point reached by the waves. Water containing the dissolved fractions will percolate through the sand and mud as wave wash returns to the ocean. Rocky shores and structures will be primarily affected by oil coating. Volatilized elements will be moved by prevailing air currents.

Oil spills may result in any of a wide range of hydrocarbons reaching the surf zone or beach. Fresh crudes as well as refined fuels and

lubricants are involved with offshore oil and gas exploration and production. Crudes may derive from accidents both off and onshore, as well as from normal operations. Crude oils may arrive at the shore, either from accident or from chronic low level discharges, in a condition ranging from unaltered to highly altered. Unaltered or fresh crudes will have the full range of hydrocarbon fractions present, including most of the soluble and volatile fractions. These lighter fractions tend to be the most toxic. The source of fresh crudes will be a nearby spill source such as a platform, pipeline, tanker, or barge. For a more distant source, in terms of time, the crude will consist of tarry lumps.

Oil spilled from onshore transportation or treatment activities may contaminate soil, vegetation, fresh water, or the marine shoreline if it is not controlled and recovered. If not contained, such spills usually reach waterways or storm sewers, ultimately winding up in the marine environment. More heavily weathered crude will have lost its lower boiling fractions and the dissolved fractions will be diluted, volatilized, oxidized, or biogenically degraded to the point of being largely or wholly undetectable. These older crudes range from highly viscous or tarry lumps which are sticky and flow under solar heating to amalgams resembling chunks of asphalt paving material consisting of non-sticky hydrocarbons and sand or pebbles. In the surf, the oil tends to adsorb to whatever clays or other fine particulates are present, sinking to become part of the bottom sediment system. On the sand, oil will both seep into the sand and be refloated by subsequent waves. Oil which has seeped into the sand or been buried by shoreline processes will either succumb to microbial decomposition or remain buried until exposed by seasonal or long-term changes in shoreline sediment processes. Oil which has flocculated with fine silts will usually become part of the sediments in low energy environments (mud flats) which are generally anaerobic, thus, will undergo little further decomposition. Microbial decomposition effectiveness appears to be variable. No single species can degrade a complete crude; the bacteria are quite selective and total oxidation requires numerous species. Some intermediate products formed by microbes or other natural processes may be more toxic than the parent hydrocarbons; and the fractions most readily oxidized are the least toxic, i.e., the normal paraffins (Bender, et al., 1977, and Bieri, 1977). The net result is that potentially toxic materials will remain in the sand or gravel and are periodically re-exposed. In estuarine areas, the oil collects in root crowns of vegetation and seeps into the sediments to depths of up to 70 cm (Burns and Teal, 1971). Vegetation effects can be expected, ranging from growth stimulation for moderate dosages, to fairly heavy mortality involving shoots and/or roots. Heavy vegetal mortality could result in remobilization of marsh or estuarine sediments with consequent changes in sediment equilibrium.

Spills reaching rocky shorelines will coat rocks and cliffs in the intertidal and supratidal zones. Thicknesses will range from a monomolecular layer (visible sheen) to very thick (several centimeters).

Highly refined lighter fraction materials or fresh crudes will be more toxic than heavier or more weathered hydrocarbons. Attached and free-swimming fauna may be affected (Bender, et al., 1977) as well as animals using the sea's surface or passing through the surf zone. Those include birds and pinnipeds. Damage may occur from toxicity, smothering, disruption of thermoregulatory functions by oiling of feathers or fur and by clean-up activities. Changes in the appearance of rocks and cliffs, may be evident due to the adherence of black or brown oil. Weathered oil is also avoided as a settlement site by intertidal organisms, thus, it becomes a space competitor for the organisms and attached algaes.

Aside from the initial impact of oil on the shoreline, subsequent activities to control and recover spilled material may cause additional or alternative impacts. Control and clean-up activities may utilize the placement of booms, air curtains, and straw or other sorbents. Dispersants are used occasionally to break up and sink advancing slicks; while steam cleaning is used to remove oil from rocks and heavy equipment is used to remove oil soaked sorbents or sand. Booms or air curtains are unlikely to have significant effects unless equipment used to install or recover them is the source of some beach or shallow bottom disruption. Straw and other sorbents will temporarily litter the beach and surf zone but not be lasting. Heavy equipment used to deploy and recover the sorbents will be the greatest source of damage. Trucks, dozers, and front end loaders, etc., will cause the loss of some sand by removal, killing of some sand dwelling species through crushing or desiccation and probable damage to beach vegetation. The building of temporary roads for access to the beach over coastal dunes or bluffs will be a relatively long-term adverse effect. Where clean-up involves the actual removal of soiled sand, the loss of large quantities of sand will result in the loss of whatever organisms may remain in the sand and a possible upsetting of the beach sand budget and, consequently, its equilibrium. The use of detergents has fallen somewhat into disfavor as many of them are toxic themselves and by sinking oil, assure that it will be available to benthic organisms. The past use of detergents in some cases, such as the Torrey Canyon incident resulted in damage which exceeded that caused by the oil itself. Steam cleaning has also been used to cleanse oil fouled rocks but its use creates heavy damage to the encrusting community through both heat damage as well as the detergents involved.

Discharges from both onshore and offshore installations may affect shoreline water quality. Wastewater discharges are controlled by both the State and the EPA, but tolerances allowed and accidents may result in occasional alteration of nearshore water quality. Domestic sewage and kitchen wastes as well as produced water make up potential wastewater discharges from platforms and drilling rigs. Produced water, if it is not re-injected, contains entrained oil (no greater than 50 ppm), dissolved fractions of crude and variable concentrations of differing brine components.

Construction activities resulting from this proposal represent another possible impact source. Actions may include the construction of piers, jetties, pipelines, separation and support facilities, and dredging. Piers and jetties change the visual character of the beach and may alter sand transport mechanisms, thus, altering shape. A positive benefit could result where beach sand transport control is necessary. Another change is the creation of hard substrates by pier pilings and jetty rocks which enriches the ecosystem by enlarging the hard bottom communities.

Pipeline construction may impact shorelines in two ways. Burial of the line in the surf zone through the beach ridge and beyond creates disruption of the bottom, resuspension of sediments, temporary changes in the beach profile, and temporary or permanent vegetation destruction. The area involved will be approximately 9 to 15 m wide (30 to 50 feet) The other source of impact from pipelines arises from a method sometimes used to install them called "pulling". With this methodology, the pipeline is assembled on the shoreline and pulled into place offshore by a tug. Impacts arise from storage of pipe sections and from the heavy equipment needed to assemble the pipe sections and weld them together. Ramps or ditches are made to guide the pipe as it is pulled into place. This method could result in considerable site disturbance if used in a non-industrialized area.

Dredging for channels would adversely affect shorelines if it involves the cutting of a new passage through the beach or bar for a new harbor or docking facility. A beneficial result could accrue from the sand being made available for beach replenishment purposes.

The last construction impact affecting shorelines would be the building or enlargement of existing facilities for separation, treatment and storage of produced hydrocarbons and for support facilities. These facilities involve grading, road construction, building of small structures, tanks, and industrial equipment. Sediment is mobilized, vegetation is altered and the possibility of odors exists. This may result in alteration or destruction of habitat for both plants and animals.

A change in the quality known as solitude will be caused by the presence of facilities and the activity involved in spill clean-up. Solitude, an important aspect of both human and faunal environment, or its absence, can strongly affect the environment's attractiveness to both. A mixed result can occur. The presence of extensive human activity or facilities where none previously existed, particularly construction noise, is a negative impact. Conversely, in an unusual case in the Santa Barbara Channel area, the presence of some facilities has created access difficulties to some shorelines for humans which has resulted in the necessary solitude to encourage utilization of nearby beaches by seals and sea lions.

2. Impact on Coastal Vegetation: The following discussion is concerned only with impacts upon upland terrestrial vegetation which occur within the coastal zone. For discussions of impacts upon kelp beds and wetland vegetation, refer to Sections II.C.1.g and h, respectively.

a. Impacts within the Southern California Bight Area

Santa Barbara Channel Area Impacts. Within this area there occur basically two centers of more-or-less natural coastal vegetative communities. These are; 1) between Point Arguello and Naples, where grassland and woodland-brushland communities occur, and 2) between Mugu Lagoon and Solromar where a woodland-brushland community occurs (see Figure II.F.4.2-1). In addition, dense concentrations of agricultural crops occur throughout this area as do sporadic concentrations of ornamental vegetation.

Direct impacts upon coastal vegetation would result if onshore facilities associated with the proposed action are placed within the coastal zone. Using the basic assumptions summarized in Table I.A.2-3, direct impacts upon coastal vegetation within the Santa Barbara Channel Area are expected to be minimal. If onshore facilities or staging areas are located within the coastal zone, vegetation will be directly impacted through its removal in the clearing process prior to construction. At this time, it is assumed that two staging areas will be located within the Santa Barbara Channel Area. A total of 12 hectares (30 acres) will therefore be directly impacted due to construction of onshore staging areas. At this time the exact location of these areas can not be determined.

Other direct impacts upon coastal vegetation due to the proposed action would result from possible oil spills. People and equipment employed in oil clean-up operations could adversely affect the coastal vegetation which may occur within the clean-up area. The destruction of the coastal vegetative community would be of a relatively short-term nature.

Changes in air quality due to the proposed action could have an impact upon agricultural crops. Dense concentrations of crops susceptible to increases on ozone levels occur in Carpinteria, east Summerland, and between Goleta and El Capitan. Citrus crops (important economically) are significant among the ozone-susceptible plants. Agricultural crops near Naples, Carpinteria and southern Goleta are also susceptible to increases in sulfur dioxide or other pollutants (AQMP,1977). Table III.E.2-1 lists various crops and relative sensitivites to three pollutants.

San Pedro Bay Area. Impacts upon coastal vegetation within this area are expected to be minimal and would primarily result from changes in

air quality due to the proposed action. Some coastal vegetation in the northern Orange county area associated with estuaries (see Section III.C.1.g) may occur directly through possible oil spills (see previous discussion).

Dana Point-San Diego Area Impacts. Between San Clemente and Oceanside (Camp Pendleton) a grassland community occurs (Figure II.F.4.2-1). In addition, ornamental and some agricultural crops located within the coastal zone may be impacted by the proposed action. No onshore facilities are expected to be constructed within the Dana Point-San Diego Area. Therefore the only impacts on coastal vegetation would be indirect or secondary in nature.

Possible oil spills and the necessary clean-up operations may result in some physical damage to coastal vegetation. Changes in air quality due to the proposed action may also affect coastal vegetation through retarded growth or actually killing of viable plants.

Santa Rosa Area Impacts. Coastal vegetation on the northern Channel Islands could be impacted by the proposed action through oil spills or changes in air quality. For a more complete discussion see Section III.C.1.i.

Tanner-Cortes Area Impacts. No direct impacts on coastal vegetation are expected due to actions in this area. Indirect impacts may occur as a result of air quality changes due to operations within this area. However, these are expected to be minimal.

Santa Barbara Island Impacts. Santa Barbara Island may be directly impacted due to oil spills (see previous discussion). Indirect impacts may occur due to air quality changes. However, these are expected to be minimal.

b. Baja California Impacts: Direct impacts upon the coastal vegetation of northern Baja California would be expected only as the result of oil spilled from an offshore source crossing the international boundary and impinging upon the shoreline. Even then, however, direct impacts due to toxic effects and/or smothering are not expected to reach coastal vegetation but rather be limited to the intertidal zone. Indirect or secondary impacts would be expected from such a spill due to onshore activities of clean-up crews, equipment, or materials used in the clean-up process.

Additional secondary impacts may occur as a result of changes in air quality. However, in order for such impacts to occur, treatment, transfer, and/or storage facilities would need to be located close to the international boundary. Impacts would depend upon the distance from the pollutant source, time of year, and duration of the adverse condition.

Table III.E.2-1

CROP LISTING AND SENSITIVITY
SUMMARY FOR THE SANTA BARBARA CHANNEL

Species	Ozone	PAN*	SO_2	
cabbage	I	R	S	truck crops
lettuce	S	S	S	
melon	S	R	R	
pumpkin	I	R	S	
squash	R	R	S	
tomato	S	S	I	
corn	S	R	R	field crops
field mixed	S	R	R	
alfalfa	S	I	S	pasture
pasture mixed	I	I	I	
avocado	R	R	R	citrus & avocado
lemon	S	R	R	
orange	S	R	R	
olive	R	R	R	deciduous fruit & nuts
walnut	R	R	R	
ornamental mixed	S	I	I	ornamentals
vineyard	S	S	S	grain
wheat & barley	I	I	S	
grain mixed	S	S	S	

S = SENSITIVE I = INTERMEDIATE R = RESISTANT

*peroxyactyl nitrate .

c. Tankering Leg Impacts (Point Conception to Point Reyes): The only impacts likely to occur on coastal vegetation would result from offshore oil spills impinging upon the shoreline. The impacts expected would be mainly secondary in nature, resulting from onshore activities of clean-up crews, possible access road construction and staging area locations.

d. Cumulative Impacts and Summary: Cumulative impacts due to the proposed action would result directly from the utilization of approximately 24 hectares (60 acres) onshore as staging areas. If these sites were occupied by coastal vegetation, this would add to the already diminishing natural, agricultural and/or ornamental vegetation areas being experienced as the result of "urban sprawl". The additional danger of oil spills due to operations resulting from the proposed action would increase the possibilities of impacts upon the coastal vegetation (see discussion). Finally, additional changes to air quality in an air basin already stressed could impact coastal vegetation. The degree of these impacts would depend heavily upon the season, geography of the area, prevailing winds and the amount and type of air pollution produced. Such impacts on economically important vegetation (agricultural crops) may have economic implications.

3. Impact on Shorebirds and Coastal Birds

a. Introduction: This section describes the major impacts of the proposed action on shorebirds and coastal birds, including bird nesting sites and rookeries, and the major cumulative impacts from related actions in the study area. Most impacts on shorebirds and coastal birds will occur in the Southern California Bight around the proposed lease areas. According to the most probable development scenario in Section I, the Santa Barbara Channel will have the most resource potential and development activity, followed by the Tanner-Cortes Banks area and the San Pedro Bay area. Outside the Southern California Bight, projected oil spills from the proposed action could impact shorebirds and coastal birds off Baja and central California.

This section considers impacts over the projected life of the proposed development, or 25 years. Most probable development and impact scenarios to the year 2000 for the proposed action described in Sections I and III.A were used to analyze the major impacts. The oil spill model results described in Section III.A and POCS Reference Paper No. VI were also considered. Section II.F.1 and POCS Reference Paper No. I describe the shorebird and coastal bird populations and habitats in the study area.

The impact analysis starts with a brief description of the major impact types from the proposed action, continues with an area by area analysis of the major impacts from the proposed action on the coastal birds, populations and habitats for the three development phases, and concludes with a brief summary of the major cumulative impacts for related actions for each area.

b. Impact Types: As a result of the proposed action, impacts on the shorebird and coastal bird populations and habitats could occur from the effects of acute and chronic oil spills, the impacts of increased human disturbance and habitat loss, and the potential for increased contamination of the ecosystem and the birds' food supply.

Lethal and sublethal effects from oil spills would cause the most significant impacts on shorebird and coastal bird populations from this proposed action.

Section III.C.1.d, Impact on Pelagic Seabirds, presents a detailed discussion of the major general impacts on birds mentioned above. The following discussion considers additional information on potential impacts to shorebirds and coastal birds and the onshore bird nesting and breeding sites in the study area.

Bourne (1968), stated that the effects of oil on the various species of birds is usually related to their varying behavior patterns. Aerial species (e.g., gulls, terns) are unlikely to plunge into oil deliberately, and coastal species (e.g., sandpipers, plovers) may paddle over it or squat in it on shore, usually without any major effects. However, swimming species such as loons and grebes are compelled to bathe in it.

Generally, shorebirds have not suffered significant noticeable mortality after past major oil spills. As discussed in Section III.C.1.d, large oil spills can kill significant numbers of diving and swimming seabirds. Straughan (1971) reported that, although gulls and terns were the most abundant birds at the time of the 1969 Santa Barbara oil spill, they suffered the lowest mortality. The abundance order for birds in the Channel at the spill time was: gulls, shorebirds, waterfowl, loons and grebes, cormorants and pelicans, and other waterbirds. Loons, grebes, ruddy ducks, and cormorants suffered the highest mortality. Therefore, the most abundant bird species in a given area at a certain time will not necessarily provide the most dead birds after an oil spill. Straughan (1971) observed that most birds appeared to avoid oiled areas after the Santa Barbara spill. However, the swimming and diving birds were killed in the highest numbers. Chronic, sublethal effects from spilled oil are unknown but could include reduced egg hatchability, growth inhibition, irritation of gland tissues, and plasma osmoregulation effects discussed in Section III.C.1.d.

The nesting and breeding sites and habitats of seabirds, shorebirds, and coastal birds would be most vulnerable to oil spills during the March to August nesting and breeding season in the Southern California Bight. For the sandy beach habitat, the endangered California least tern and the snowy plover are important nesting species. The endangered light-footed clapper rail and Belding's savannah sparrow are completely dependent on the salt marsh vegetation habitat for nesting, roosting, and feeding. The rocky shore habitat on the Channel Islands is the only nesting habitat in Southern California for cormorants, the endangered brown pelican, Xantus' murrelet, the ashy and black storm-petrels, the pigeon guillemot, and is a significant nesting habitat for western gulls. The only breeding colonies for brown pelicans in California are on Anacapa and Santa Cruz Islands. The brown pelican is a plunge-diver for fish and could be vulnerable to an oil spill hitting the coastal waters of Anacapa and Santa Cruz Islands. However, since pelicans visually search for fish from the air before they dive, a thick surface oil slick would deter them from diving for food. As discussed in Section III.C.1.d, pelicans historically have not been significantly damaged by major oil spills. Typical coastal species such as cormorants, pelicans, and gulls roost on shore at night and forage at sea by day up to several tens of kilometers from land. Figure III.E.3-1 shows the major bird roosting sites along the mainland coast.

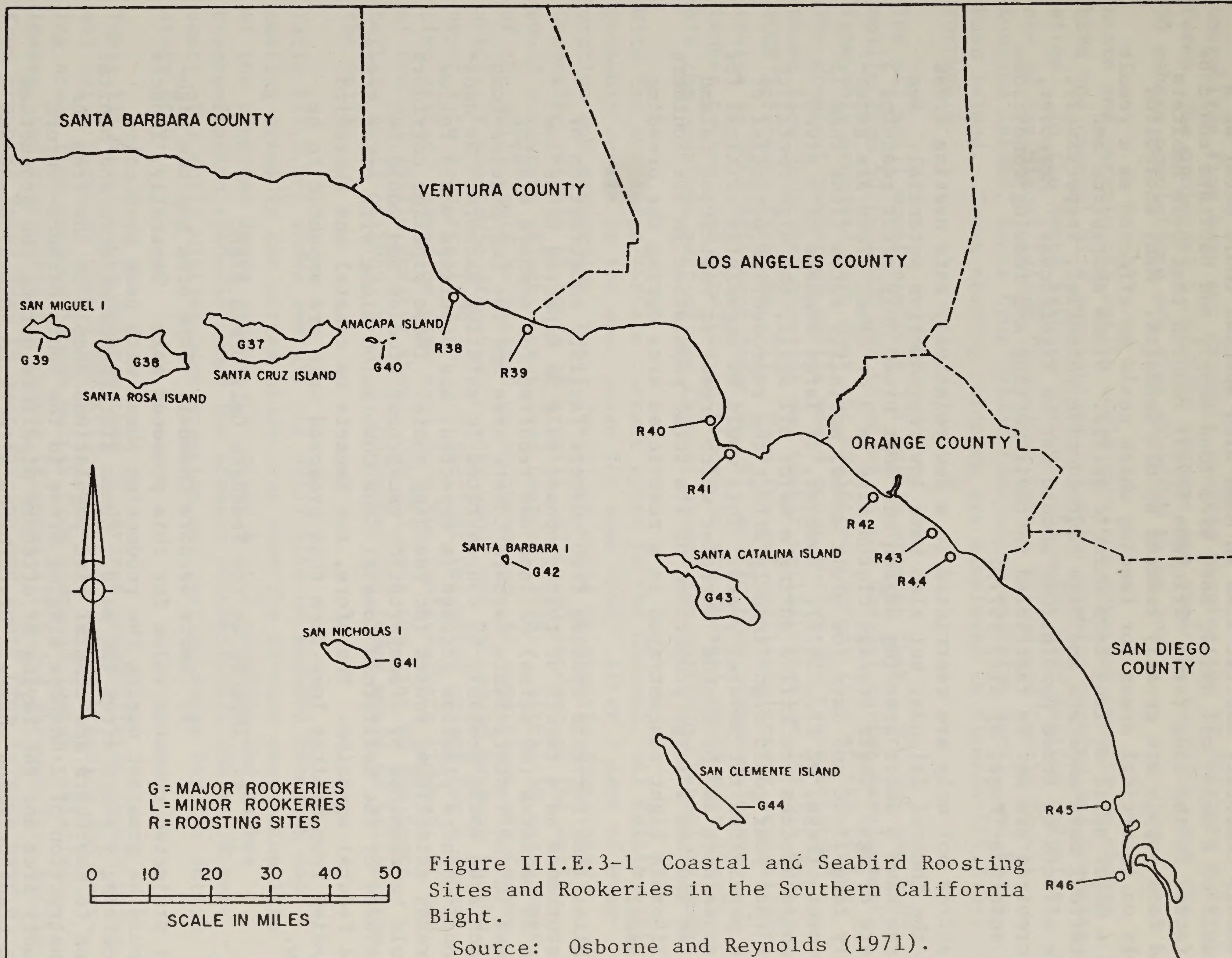


Figure III.E.3-1 Coastal and Seabird Roosting Sites and Rookeries in the Southern California Bight.

Source: Osborne and Reynolds (1971).

Although temporary habitat loss to some bird species could occur as a result of a major oil spill, both bird food supply and habitats could be affected in the long term. Erickson (1963) reports that both habitats and food supply are greatly reduced by oil deposits. Many shorebirds rely on intertidal areas for feeding which could be affected as a result of a major spill or long-term chronic spills. Since shorebirds and waterfowl have moderate and high reproductive potential, respectively, the effects on these populations should not be significant. Moreover, shorebirds are not as restricted in their nesting and feeding conditions as seabirds (Page, et al., 1977).

Seabirds not only are restricted to a few relatively safe nesting areas on the Channel Islands, but also have low reproductive potential. Seabirds have a short breeding season and most breed only after reaching 3 years of age. their average clutch size is 3 or less. They are generally long-lived and have low adult annual mortality rates (less than 15 percent) (Page, et al., 1977). However, if large numbers of a given seabird species are killed during a major oil spill, the high mortality for that year could significantly affect the reproductive potential of the population for several years. This would be especially critical for species such as the Xantus' murrelet which breeds at restricted island sites and has a large proportion of its total population in the Southern California Bight concentrated in a restricted area during the breeding season.

Habitat loss for bird species from onshore facility construction or disturbance as a result of this proposed sale is expected to be low. The 24 hectares (60 acres) of land use required for onshore staging areas in the Ventura-Santa Barbara County area and the Los Angeles-Long Beach area would probably be concentrated in existing harbors. No additional onshore pipeline acreage is expected, and pipelines would follow already established routes for reaching shore. These pipeline corridors would be examined by transportation management studies and would be reviewed by the California Coastal Zone Commission along with other State and Federal agencies. Therefore, the impacts on coastal and shorebird species from habitat loss from this proposed sale are expected to be low.

c. Impacts on the Southern California Bight

i. Santa Barbara Channel: This area has the highest projected resource value for this proposed sale. Generally, impacts should be greatest during the production phase with peak production occurring 8 years after the sale. Human disturbance effects and habitat loss to shorebird and coastal bird populations should be low from the construction of 2 onshore staging areas in the Santa Barbara-Ventura County area and the laying of offshore pipelines during the production and transportation phases. Disturbance effects to coastal birds and

shorebirds from boat and aircraft traffic serving the 10 offshore platforms, the projected 1 offshore storage and treating facility, and the 30 subsea completions are also expected to be low.

Acute and chronic oil spills would have the greatest impacts on shorebird and coastal bird populations and major seabird nesting and breeding sites. In the Santa Barbara Channel, the major bird nesting colonies are on San Miguel Island (including Prince Island and Castle Rock), Anacapa Island, Santa Cruz Island (including Scorpion Rock), and Santa Rosa Island. These nesting colonies are displayed in Figures III.E.3-2 through 6.

The oil spill model predicts 3.1 spills greater than 1,000 bbl and 6.05 spills from 50 to 1,000 bbl to occur in the Channel during development from this proposed sale over the projected 25-year life of the fields. The greatest number of spills would occur during the transportation phase from projected pipeline and tanker spills (Section III.A.4 and POCS Reference Paper No. VI). From the oil spill trajectory probability tables in POCS Reference Paper No. VI, spills from proposed leases, tanker routes, and pipeline corridors in the Channel would most likely hit the southern part of the Channel around the northern Channel islands.

With the two large surface current gyres in the Channel, oil spills will probably remain in the open ocean for some time. After 3 days of evaporation and dispersion, toxic fractions would be greatly diminished. Generally, within 48 hours of a spill, 40 to 60 percent of the spill would evaporate (Slack, Wyant, and Lanfear, 1978). Within 10 days, most of the spill could be cleared up or contained, if conditions are favorable. If non-toxic dispersants were used, the oil could be kept in the upper 3 to 4 meters (9.9 to 13.2 feet) of the water column for a longer time period. Based on past data from the Santa Barbara blowout, if one of the 3.1 spills greater than 1,000 bbl were the size of the Santa Barbara spill of 1969, about 3,700 grebes and loons would be killed from the spill.

Table III.E.3-1 shows overall oil spill hits on seabird breeding and nesting areas in the entire study area over the 25-year production life of the proposed lease areas. The mixed A or B pipeline and tanker transportation scenario shows the highest probabilities (64 to 78 percent) of 1 spill hitting bird breeding and nesting areas for the entire study area.

Table III.E.3-2 lists greater than 50 percent probabilities that a major oil spill (greater than 1,000 bbl) would hit seabird breeding and nesting areas from various launch points from proposed leases, existing leases, and transportation routes (Figures III.E.3-7 through 9). Spills from proposed lease area P9 near Anacapa and Santa Cruz Islands have a 68 percent probability of hitting seabird nesting and breeding areas in

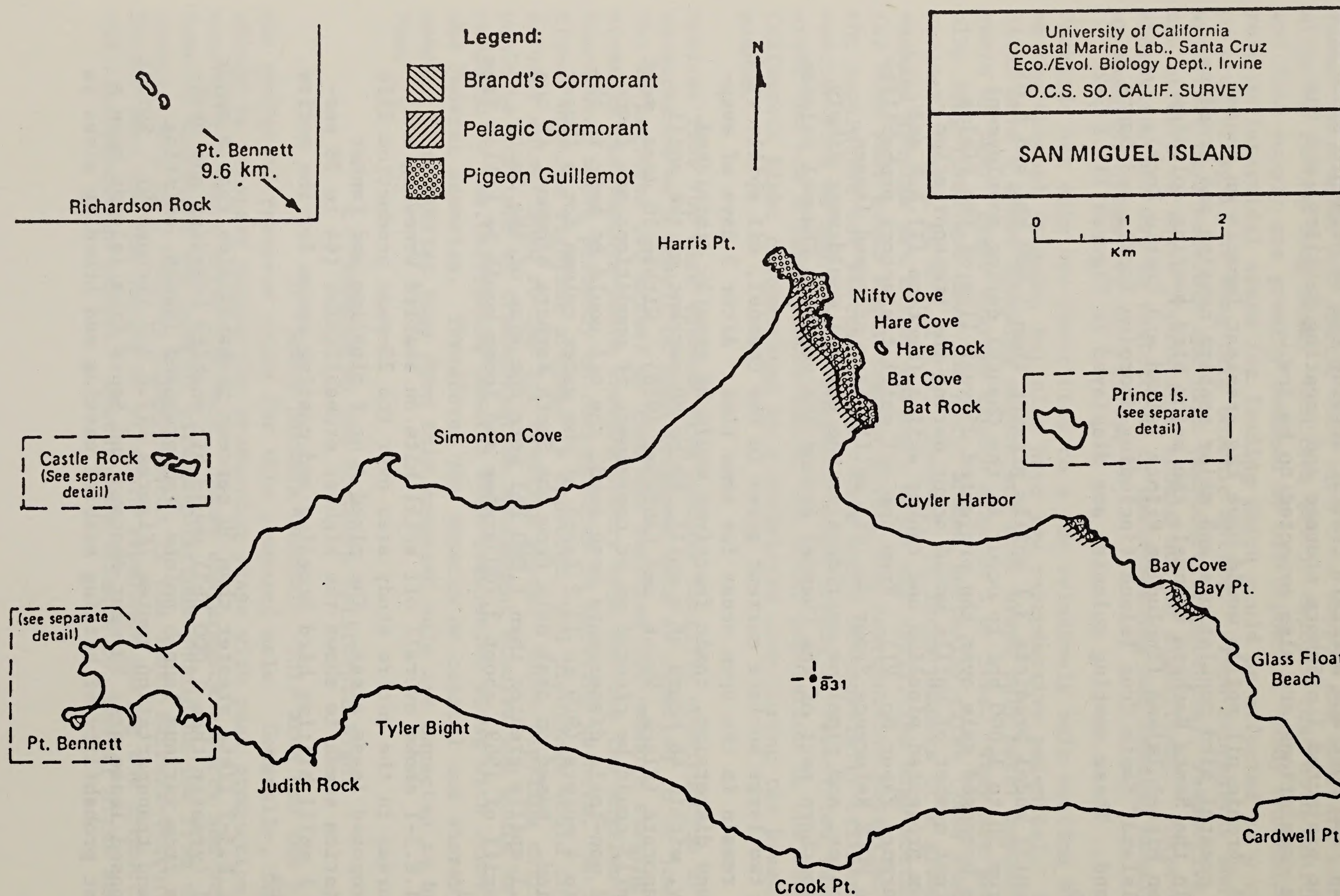


Figure III.E.3-2 Distribution of Nesting Colonies on San Miguel Island.

Source: University of California, Santa Cruz (1978).

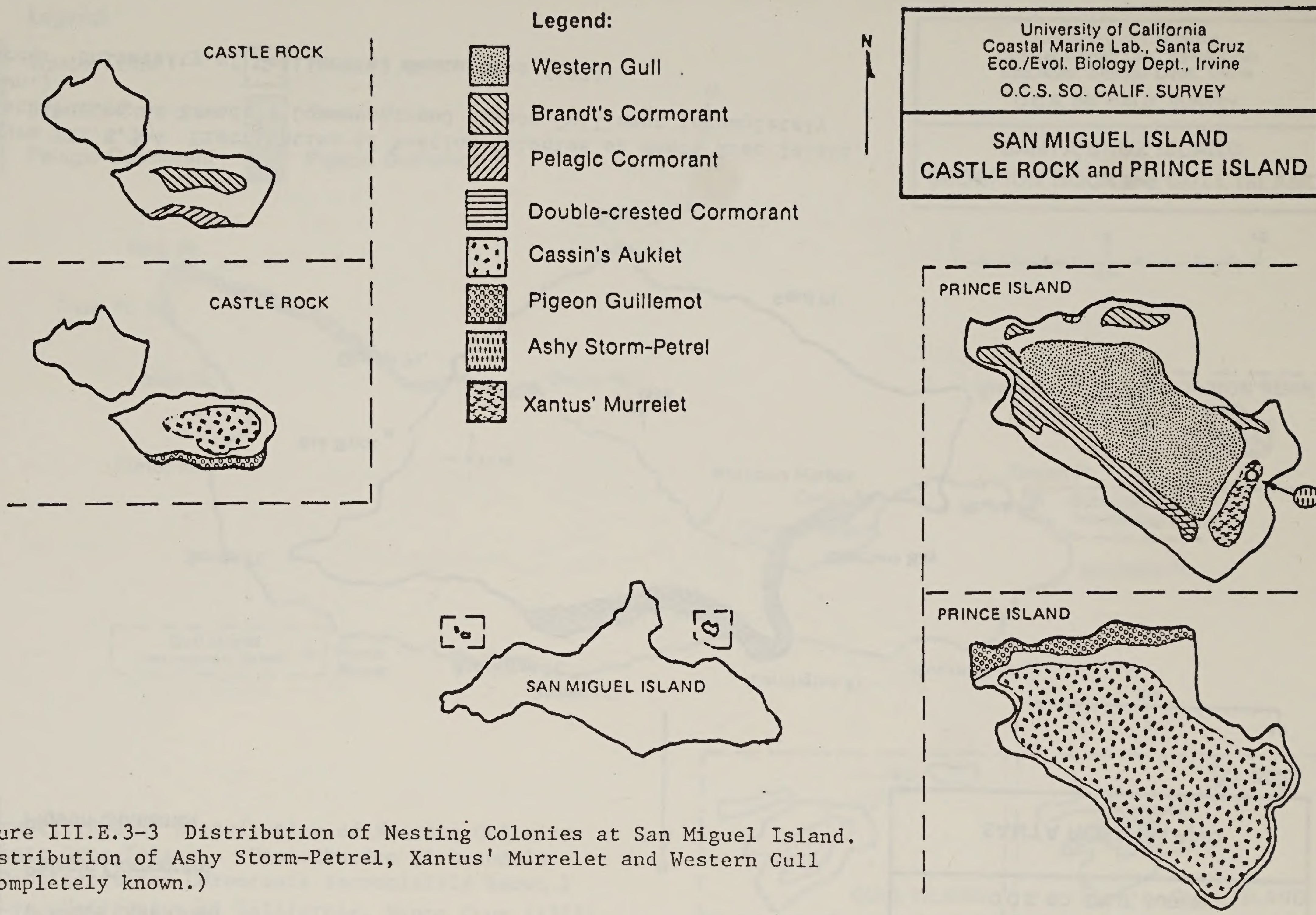


Figure III.E.3-3 Distribution of Nesting Colonies at San Miguel Island. (Distribution of Ashy Storm-Petrel, Xantus' Murrelet and Western Gull incompletely known.)

Source: University of California, Santa Cruz (1978).

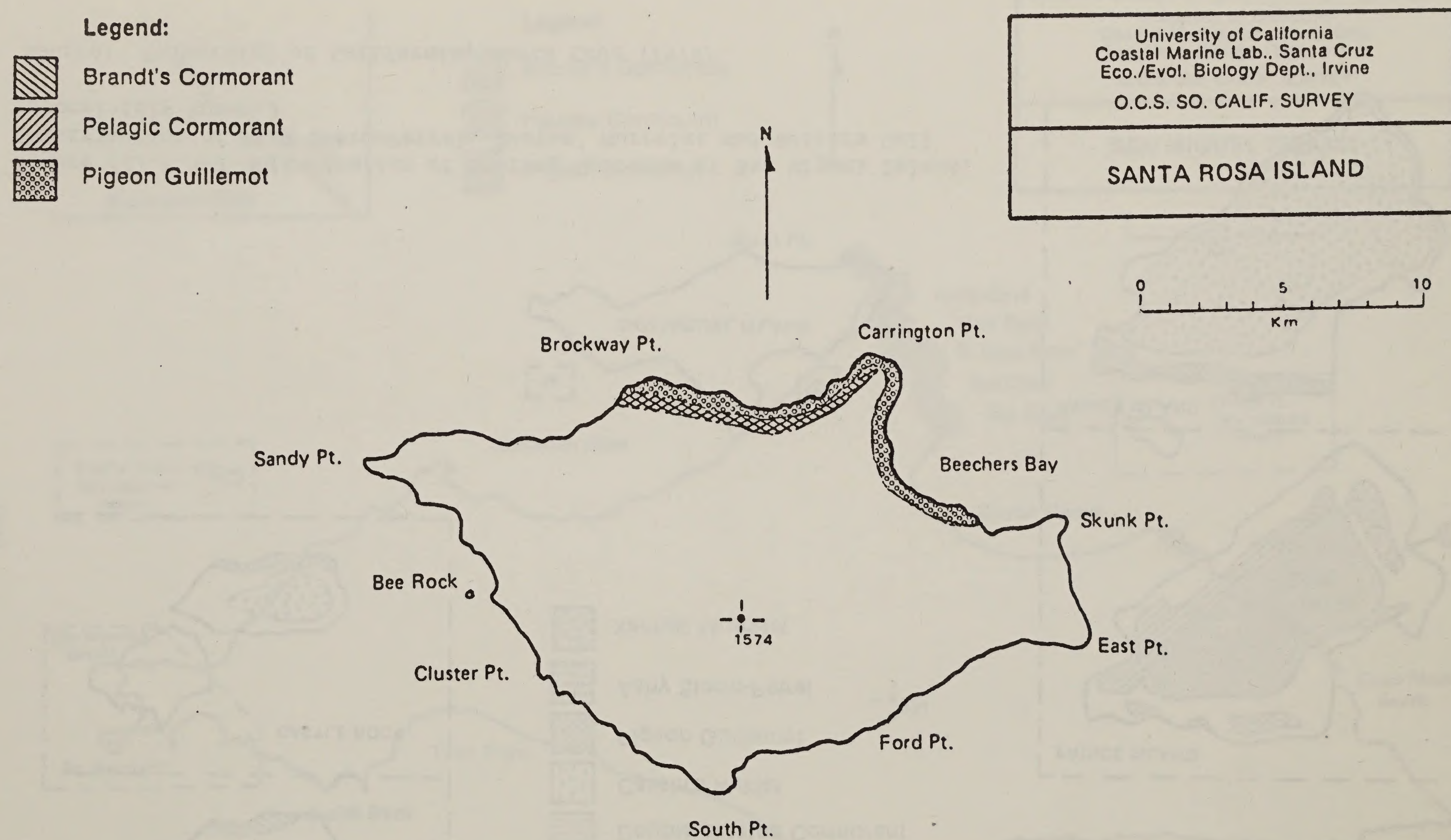


Figure III.E.3-4 Distribution of Nesting Colonies on Santa Rosa Island. (Distribution of Brandt's Cormorant and Pigeon Guillemot incompletely known.)

Source: University of California, Santa Cruz (1978).

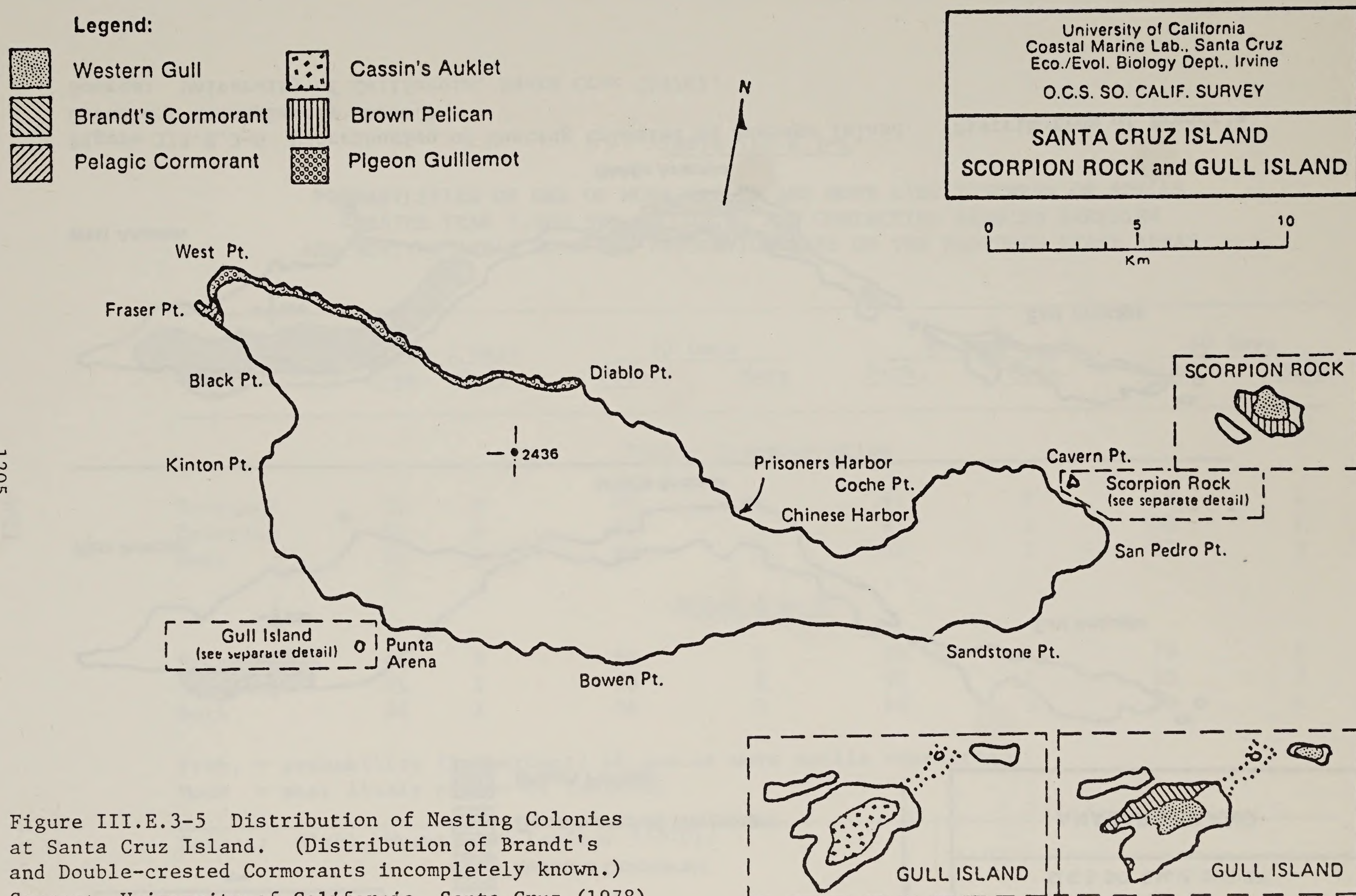


Figure III.E.3-5 Distribution of Nesting Colonies at Santa Cruz Island. (Distribution of Brandt's and Double-crested Cormorants incompletely known.) Source: University of California, Santa Cruz (1978).

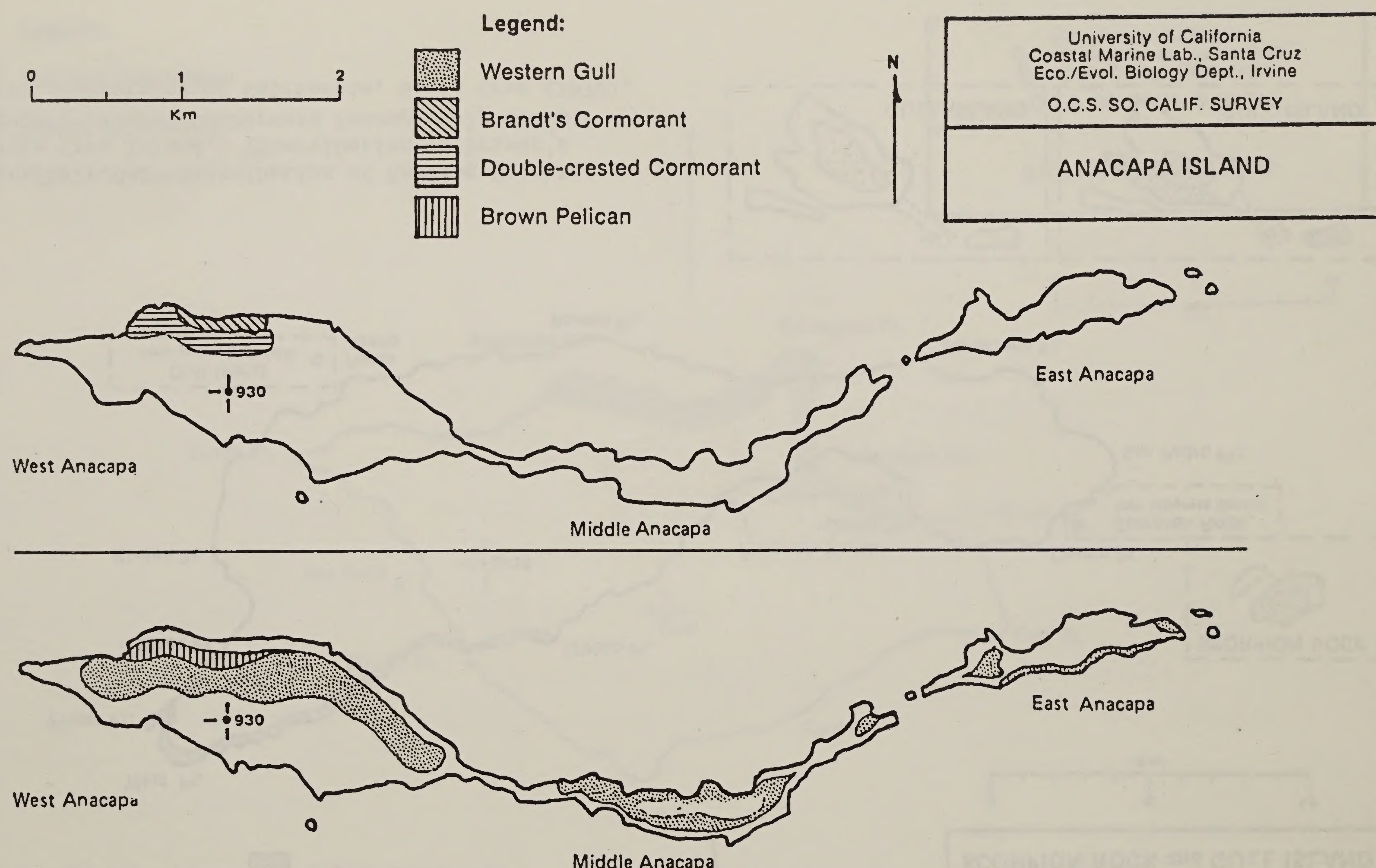


Figure III.E.3-6 Distribution of Nesting Colonies on Anacapa Island. (Distribution of Brandt's Cormorant incompletely known.)
Source: University of California, Santa Cruz (1978).

Table III.E.3-1

PROBABILITIES OF ONE OR MORE SPILLS AND MOST LIKELY NUMBER OF SPILLS GREATER THAN 1,000 BBL OCCURRING AND CONTACTING SEABIRD BREEDING AND NESTING AREAS OVER THE PRODUCTION LIFE OF THE PROPOSED LEASE AREAS

	Within 3 Days		10 Days		30 Days		60 Days	
	Prob.	Mode	Prob.	Mode	Prob.	Mode	Prob.	Mode
				Tanker Transportation				
Proposed	31	0	49	0	61	0	68	1
Existing	54	0	76	1	85	1	90	2
Both	69	1	88	2	94	2	97	3
				Mixed A or B				
Proposed	46	0	64	1	74	1	78	1
Existing	71	1	88	2	93	2	95	2
Both	84	1	96	3	98	3	99	4

Prob. = probability (in percent) of one or more spills contacting
Mode = most likely number of contacts

Source: Slack, Wyant, and Lanfear (1978).

Table III.E.3-2

GREATER THAN FIFTY PERCENT PROBABILITIES THAT AN OIL SPILL STARTING AT A PARTICULAR LOCATION WILL REACH SEABIRD BREEDING AND NESTING AREAS

	Time			
	Within: 3 Days	10 Days	30 Days	60 Days
Spill Location				
Proposed Leases				
P2		55	58	59
P8			51	52
P9	68	80	82	82
P12	52	61	66	68
Existing Leases				
E2		50	51	52
E3		57	61	62
E4		60	64	65
E5	70	78	80	80
E6	52	71	76	77
E9		50	57	60
Pipeline Routes				
L4	51	65	69	70
L6		52	55	56
L7			50	52
Tankering Routes				
T6		54	57	58

Source: Slack, Wyant, and Lanfear (1978).

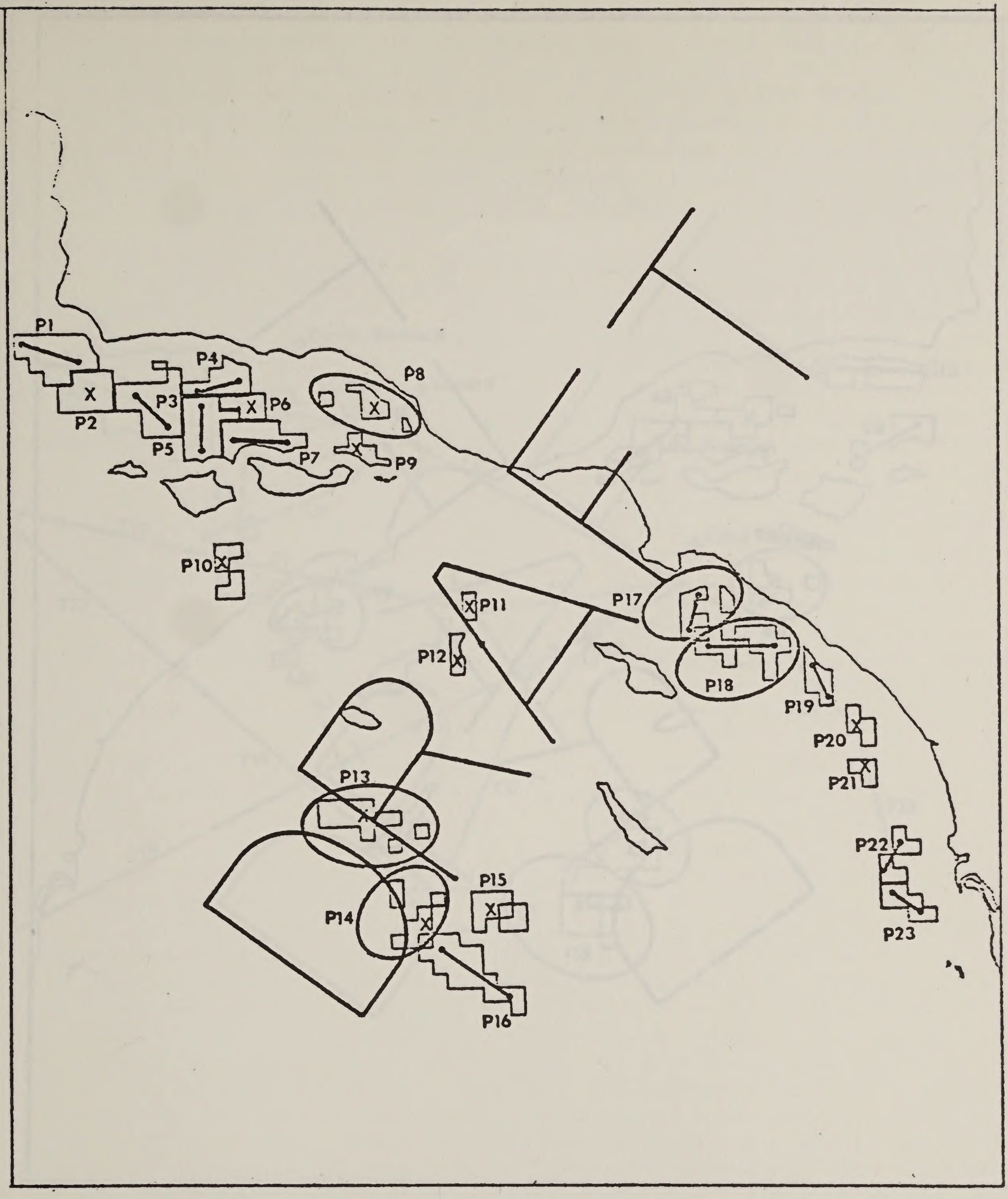


Figure III.E.3-7 Map S .owing the Subdivisions of the Proposed Leases.
Source: Slack, Wyant, and Lanfear (1978).

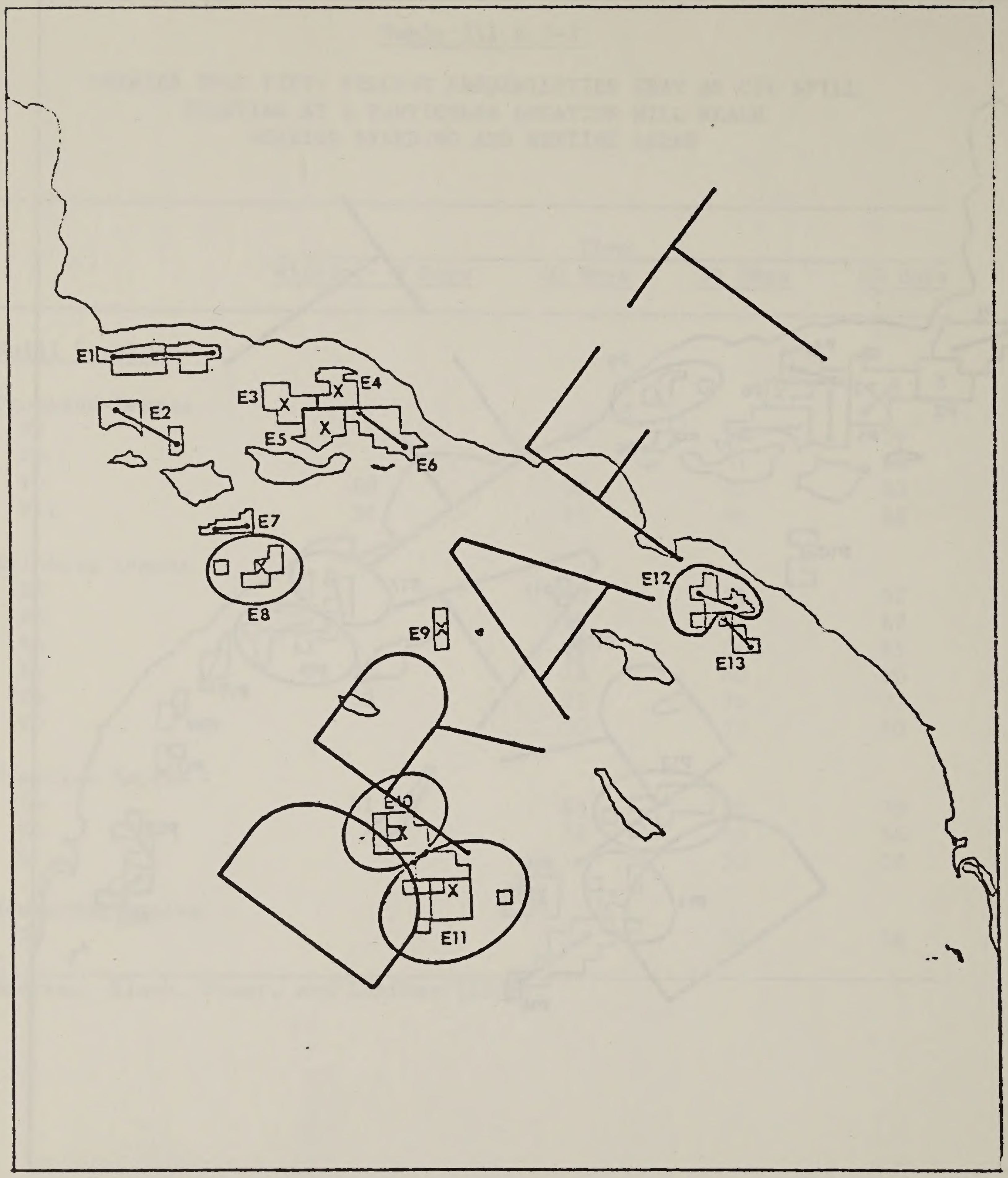


Figure III.E.3-8 Map Showing the Subdivisions of the Existing Leases.
Source: Slack, Wyant, and Lanfear (1978).

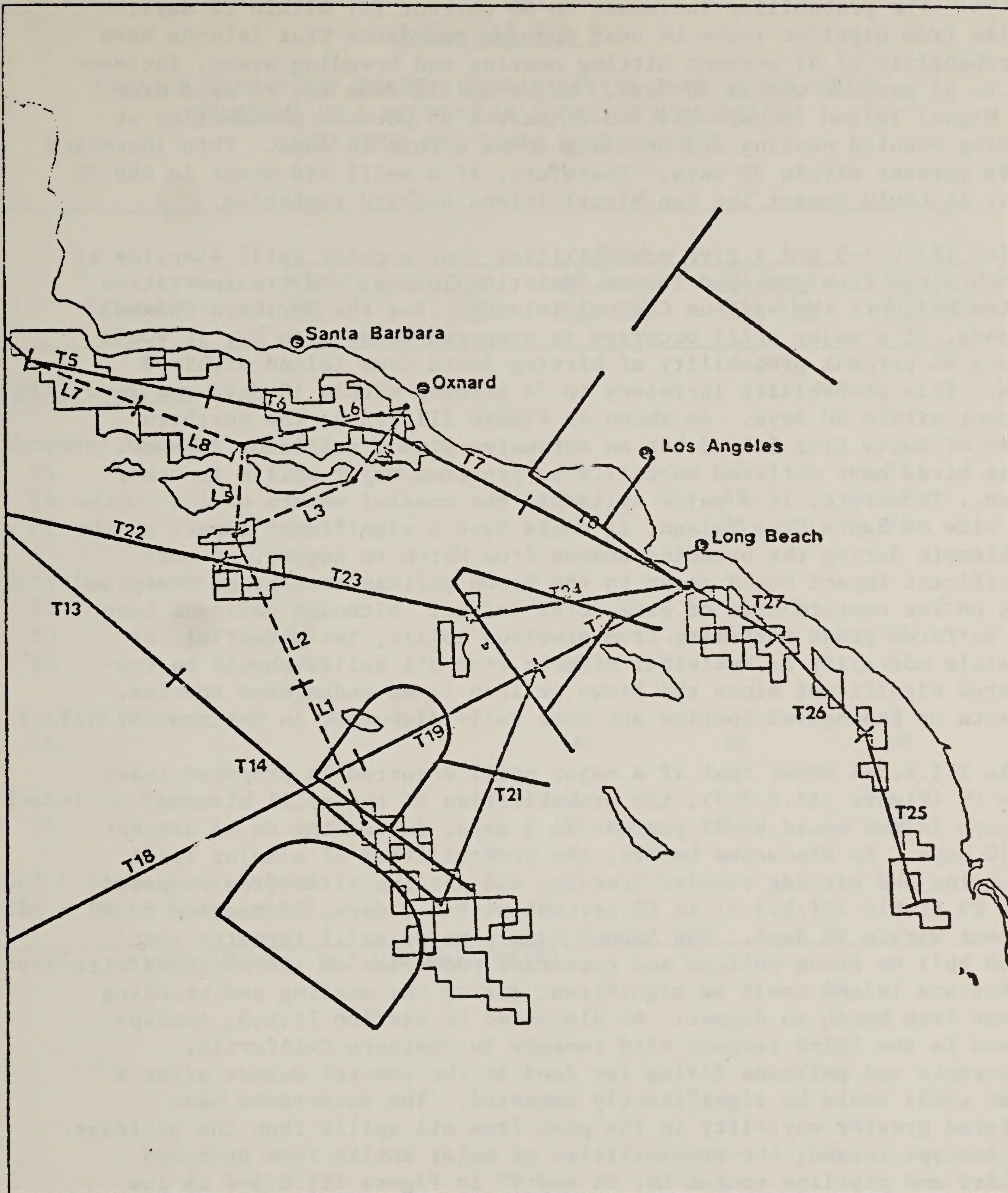


Figure III.E.3-9 Map Showing the Location of the Local Transportation Route Segments.
Source: Slack, Wyant, and Lanfear (1978).

3 days. The probability increases to 80 percent for within 10 days. Spills from pipeline route L4 near Anacapa and Santa Cruz Islands have a probability of 51 percent hitting nesting and breeding areas, increasing to 65 percent within 10 days. Major spills from the P2 area near San Miguel Island (Figure III.E.3-7) have a 55 percent probability of hitting seabird nesting and breeding areas within 10 days. This increases to 58 percent within 30 days. Therefore, if a spill did occur in the P2 area, it could impact the San Miguel Island seabird rookeries.

Tables III.E.3-3 and 4 give probabilities that a major spill starting at launch sites from proposed leases, existing leases, and transportation routes will hit the various Channel Islands. For the Northern Channel Islands, if a major spill occurred in proposed lease area P7, it would have a 64 percent probability of hitting Santa Cruz Island within 3 days. This probability increases to 74 percent within 10 days and 76 percent within 30 days. As shown in Figure III.E.3-5, the northern shore of Santa Cruz Island has an extensive pigeon guillemot rookery. These birds have suffered mortality in previous major spills in other areas. Therefore, if a major spill hit the coastal waters of the northern side of Santa Cruz Island, it could have a significant impact on the guillemots during the breeding season from March to August. A more significant impact could occur to the brown pelican rookery on Scorpion Rock on the eastern side of Santa Cruz Island. Although pelicans have not suffered great mortality from previous spills, the potential for possible mortality or sublethal effects from oil spills should be considered significant since the brown pelican is an endangered species. Impacts on Endangered Species are more fully discussed in Section III.E.5.

Table III.E.3-4 shows that if a major spill occurred in proposed lease area P9 (Figure III.E.3-7), the probabilities of the spill hitting Anacapa Island would be 37 percent in 3 days, increasing to 43 percent in 10 days. As discussed before, the probabilities of a major spill occurring and hitting seabird breeding and nesting sites from proposed area P9 (Table III.E.3-2) is 68 percent within 3 days, increasing to 80 percent within 10 days. The impact from a major spill (greater than 1,000 bbl) on brown pelican and cormorant rookeries on the northern side of Anacapa Island could be significant during the nesting and breeding season from March to August. As discussed in Section II.E.5, Anacapa Island is the third largest bird rookery in Southern California. Cormorants and pelicans diving for food in the coastal waters after a major spill could be significantly impacted. The cormorants have suffered greater mortality in the past from oil spills than the pelicans. For Anacapa Island, the probabilities of major spills from proposed tankers and pipeline routes L6, T6 and T7 in Figure III.E.3-9 is low (less than 20 percent). For proposed pipeline route L4, the probability is higher; 28 percent within 3 days, increasing to 34 percent within 10 days.

Table III.E.3-3

GREATER THAN FIFTY PERCENT PROBABILITIES THAT AN OIL SPILL STARTING AT A PARTICULAR LOCATION WILL REACH SANTA CRUZ AND SANTA ROSA ISLANDS

	Time							
	Within: 3 Days		10 Days		30 Days		60 Days	
Islands:	SCI	SRI	SCI	SRI	SCI	SRI	SCI	SRI
Spill Location								
Proposed Leases								
P5			52		53		53	
P6			54		57		57	
P7	64		74		76		76	
Existing Leases								
E2				52		53		53
E3	58		61		63		63	
E5	58		66		67		67	
Pipeline Routes								
L6			56		58		58	
Tankering Routes								
T6			52		54		54	

SCI = Santa Cruz Island
SRI = Santa Rosa Island

Source: Slack, Wyant, and Lanfear (1978).

Table III.E.3-4

PROBABILITIES (IN PERCENT) THAT AN OIL SPILL STARTING AT A PARTICULAR LOCATION WILL REACH SAN MIGUEL, ANACAPA, AND SANTA BARBARA ISLANDS

	Time											
	Within: 3 Days			10 Days			30 Days			60 Days		
Islands:	SMI	SAI	SBI	SMI	AI	SBI	SMI	AI	SBI	SMI	AI	SBI
Spill Location												
Proposed Leases												
P1	18			25			26			27		
P2	32			37			38			38		
P8		6			16			18			18	
P9		37			43			43			43	
P11			8			12			14			14
P12			12			16			18			18
Existing Leases												
E1				9			11			11		
E2	20			22			22			22		
E4		19			28			29			29	
E5		15			17			17			17	
E6		21			30			32			32	
E9			9			13			15			16
Pipeline Routes												
L4		28			34			34			34	
L6		11			15			16			16	
L7	22			27			29			29		
Tankering Routes												
T5	12			12			28			18		
T6		11			14			15			15	
T7		7			16			17			18	

SMI = San Miguel Island; AI = Anacapa Island; SBI = Santa Barbara Island

Source: Slack, Wyant, and Lanfear (1978).

For the San Miguel Island area, if a major spill occurred in proposed lease area P2, the probabilities of it hitting the island are 32 percent within 3 days, increasing to 37 percent within 10 days. From proposed area P1, the probabilities are lower, from 18 percent within 3 days to 25 percent within 10 days. Major oil spill hits from pipeline route L7 are 22 percent (in 3 days) to 27 percent (in 10 days) and from tanker route T3 are 12 percent (in 3 days) to 17 percent (in 10 days). San Miguel Island is the largest seabird rookery in the Southern California Bight, as discussed in Section II.E.5. The large colonies of cormorants, guillemots, Xantus' murrelets, and ashy storm-petrels (Figures III.E.3-2 and 3) could be significantly impacted by a major oil spill. These bird groups have historically suffered high mortality from major oil spills. (See Table III.C.1.d-2 in Section III.C.1.d.) A major spill hitting the areas around Prince Island, Castle Rock, or the northern tip of San Miguel Island could have severe impacts on nesting and foraging seabird populations during the March to August nesting season.

Probabilities of a major spill from proposed leases occurring and hitting mainland shoreline segments along the Santa Barbara Channel are low (less than 15 percent) for mixed pipeline and tanker transportation. For 100-percent tanker transportation, the probabilities are lower (less than 7 percent). Since the one historical major spill in the Channel area did reach shore after 7 to 10 days, major spill impacts on mainland shorebird species should be considered.

For the Santa Barbara Channel area, the most significant impacts from a major oil spill for shorebird species would be in Goleta Slough, Carpinteria Marsh, and Mugu Lagoon. Oil that enters these wetland habitats could remain for several years (Section III.C.1.h., Impacts on Estuaries). Cleanup operations within these habitats could do even more damage. The endangered light-footed clapper rail and Belding's savannah sparrow nest and feed in the salt marsh habitats in Goleta Slough and Carpinteria Marsh. The light-footed clapper rail also occurs in Mugu Lagoon. Oil spill impacts to these habitats and species could be significant. As discussed above, the probabilities of spills reaching the mainland shore from proposed lease areas from this proposed sale are low.

Shorebirds using the sandy beach and rocky shore habitats should not be significantly affected by spills. Any effects should be short term and could include dispacements of habitat and feeding areas. The shorebirds use these habitats most heavily in the winter when human disturbance is low.

The long-term, chronic impacts from major and minor spills projected over the 25-year production life of this proposed sale are unknown. Increased bird mortality and sublethal effects could result in lower species diversity and population numbers in the Channel.

ii. San Pedro Bay: This area has the third highest projected resource value for this proposed sale. Oil production will peak in 7 years after the proposed sale, or in 1986. The impacts on shorebirds and coastal birds from human disturbance effects and habitat loss would be low from the projected 102.4 km (64 miles) of offshore pipelines and 2 onshore staging areas to be constructed in the Los Angeles-Long Beach area. Disturbance effects from boat and aircraft traffic servicing the platforms and the 7 projected subsea completions are also expected to be low. The greatest effects would be during the March to August breeding season.

The oil spill model predicts only 0.47 spills greater than 1,000 bbl and 1.38 spills from 50 to 1,000 bbl to occur in the San Pedro Bay area during development from this proposed sale over the projected 25-year life of the fields. The impacts on coastal birds and shorebirds in the area would be similar to those discussed for the Santa Barbara Channel, except at a much lower level since the predicted spill number is very low. The probability of an oil spill reaching shoreline segments in San Pedro Bay is low (less than 14 percent) for any spills from proposed leases. The probability increases to 30 percent within 60 days for tankering leg T8 (Figure III.E.3-9).

For the San Pedro Bay area, the most significant impacts on shorebird species from a major spill could occur if a spill hit Anaheim Bay, Bolsa Chica Bay, or Upper Newport Bay. All three habitats have endangered species nesting and feeding in them. Anaheim Bay is a National Wildlife Refuge, while Bolsa Chica Bay and Upper Newport Bay are State Ecological Reserves. Since the entrances to all three bays from the ocean are very restricted, the chance of oil from an offshore spill in Federal waters reaching these habitats is low.

Shorebirds using the sandy beach and rocky beach habitats would be impacted the greatest in the winter when human beach use is low. Any impacts from acute oil spills should be short term and could cause habitat displacement and feeding area restrictions for the spill and cleanup period.

The long-term, chronic impacts from major and minor spills predicted over the 25-year productive life of this proposed sale are unknown.

iii. Dana Point-San Diego: This area has the fourth highest projected resource value for this proposed sale but the lowest per acre. Oil production will peak in 7 years after the proposed sale, or in 1986. Any impacts on shorebirds and coastal birds from human disturbance effects and habitat loss will be minimal from the projected 24 km (15 miles) of offshore pipelines from the proposed sale. No onshore facilities are projected for this area as a result of the proposed action. Disturbance effects from boat and aircraft traffic servicing the 3 platforms, the

offshore storage facility, and the 3 projected subsea completions should also be low.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.17) and an insignificant number of 50 to 1,000 bbl spills (0.29) to occur in the area over the projected 25-year life of the fields. Therefore, the impacts on coastal birds and shorebirds in the area should be very low from oil spills. The probability of a major oil spill occurring and hitting shoreline segments along the Dana Point-San Diego coastal area is low (less than 10 percent). If a spill should occur, the greatest probability of the spill hitting the shoreline segments would be 45 percent in 60 days from the P20 lease area (Figure III.E.3-7).

For the Dana Point-San Diego Bay area, the most significant impacts for shorebird species would be in the several coastal lagoons, bays and rivers. All are habitats for endangered species, and Mission Bay and San Diego Bay support large numbers of wintering waterfowl. Several of the coastal lagoons are closed to the sea for most of the year and they all have restricted entrances. The protected California least tern, the caspian tern, and the elegant tern nest only on mainland beaches. For a worst case projection, if a spill hit their habitats during the March to August nesting and breeding season it could produce significant impacts.

The long-term, chronic impacts from major and minor spills predicted over the 25-year production life of this proposed sale are unknown.

iv. Santa Rosa Area: This area has the fifth highest projected resource value for this proposed sale. Oil production would peak in 7 years after the proposed sale, or in 1986. There would be no habitat loss impacts for coastal and shorebirds, since no onshore facilities are predicted for the Channel Islands. Any disturbance impacts should be low from boat and aircraft traffic servicing the 1 offshore platform and the 2 projected subsea completions.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.17) over the projected 25-year life of the field. Therefore, the impacts on coastal birds and shorebirds on Santa Rosa and Santa Cruz Islands north of the proposed lease area should be low. Bird nesting colonies on Santa Rosa Island are on the north side of the island (Figure III.E.3-4), but Gull Island on the south side of Santa Cruz Island could be vulnerable to any spills. Cormorants and Cassin's auklets nest on Gull Island. Since this area receives exceptionally heavy use for shallow water seabird foraging, for a worst case projection, a major spill occurring and hitting the coastal waters of Santa Rosa or Santa Cruz Island could have significant impacts on bird populations in the area.

The long-term, chronic impacts for major and minor spills predicted over the 25-year production life of this proposed sale in the area are unknown.

v. Tanner-Cortes Area: This area has the second highest projected resource value for this proposed sale. Oil production would peak in 1986. The oil spill model predicts 1.14 spills greater than 1,000 bbl and 3.17 spills from 50 to 1,000 bbl from this proposed sale over the projected 25-year field life. Since the predominant wind direction and surface current flow in the area is to the southeast, major spills occurring in the area should be carried south and southeast.

The probability of a major (greater than 1,000 bbl) spill reaching San Clemente Island from proposed lease areas in the Tanner-Cortes Banks area is less than 12 percent. Therefore, any impacts on coastal and shorebird species should be low.

vi. Santa Barbara Island Area: This area has the lowest projected resource value for the proposed sale. Production would peak in 1986. There would be no habitat loss for coastal birds and shorebirds since no onshore facilities are projected for the island. Santa Barbara Island is in the Channel Islands National Monument.

The oil spill model predicts an insignificant number of spills greater than 1,000 bbl (0.06) and an insignificant number of 50 to 1,000 bbl spills (0.09) over the projected 25-year life of the field. The probability of an oil spill occurring and hitting Santa Barbara Island is less than 10 percent. Therefore, oil spill impacts, as predicted by the spill model, should be low.

However, for a worst case prediction, if a major oil spill did occur in the coastal waters and reach the shore, the impacts could be significant to the large and diverse seabird colonies on Santa Barbara Island. These colonies are the third largest in the Southern California Bight (Figure III.E.3-10). Large numbers of cormorants, guillemots, and Xantus' murrelets use the nearshore waters for feeding, especially in May and June (University of California, Santa Cruz, 1978). Xantus' murrelets disperse to sea with their young from Santa Barbara Island in May. During field sampling in 1975 and 1976, they were observed most commonly north of the island in May and June (Figure III.E.3-11). Nesting activity on Santa Barbara Island starts in March and continues to late July. In October through December, large numbers of pelicans, cormorants, gulls, and jaegers used the coastal waters of Santa Barbara Island. Low numbers of grebes, loons, and scooters also used the nearshore waters in winter (University of California, Santa Cruz, 1978).

The long-term, chronic impacts of oil spills on coastal bird species are unknown.

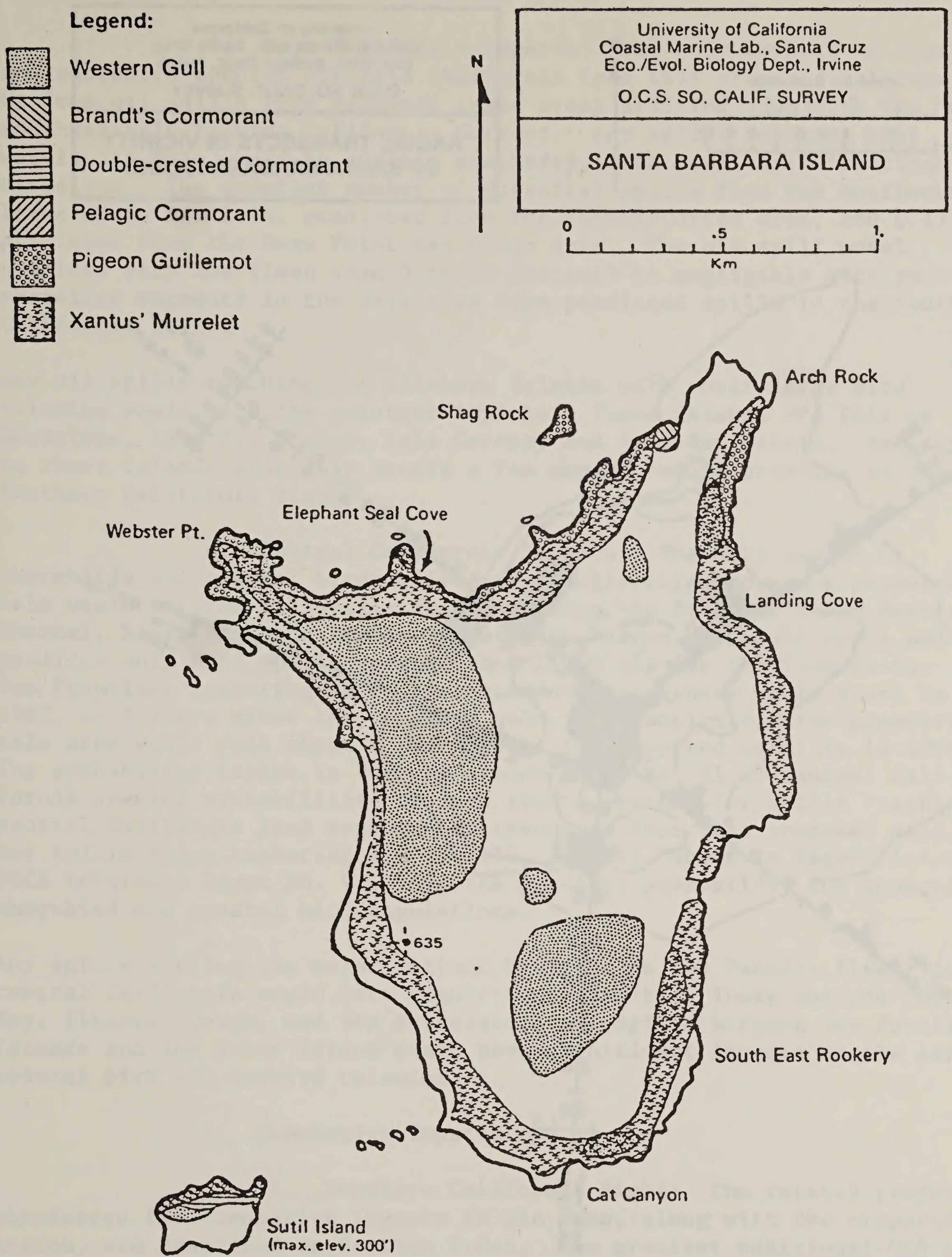


Figure III.E.3-10 Distribution of Nesting Colonies at Santa Barbara Island.
Source: University of California, Santa Cruz (1978).

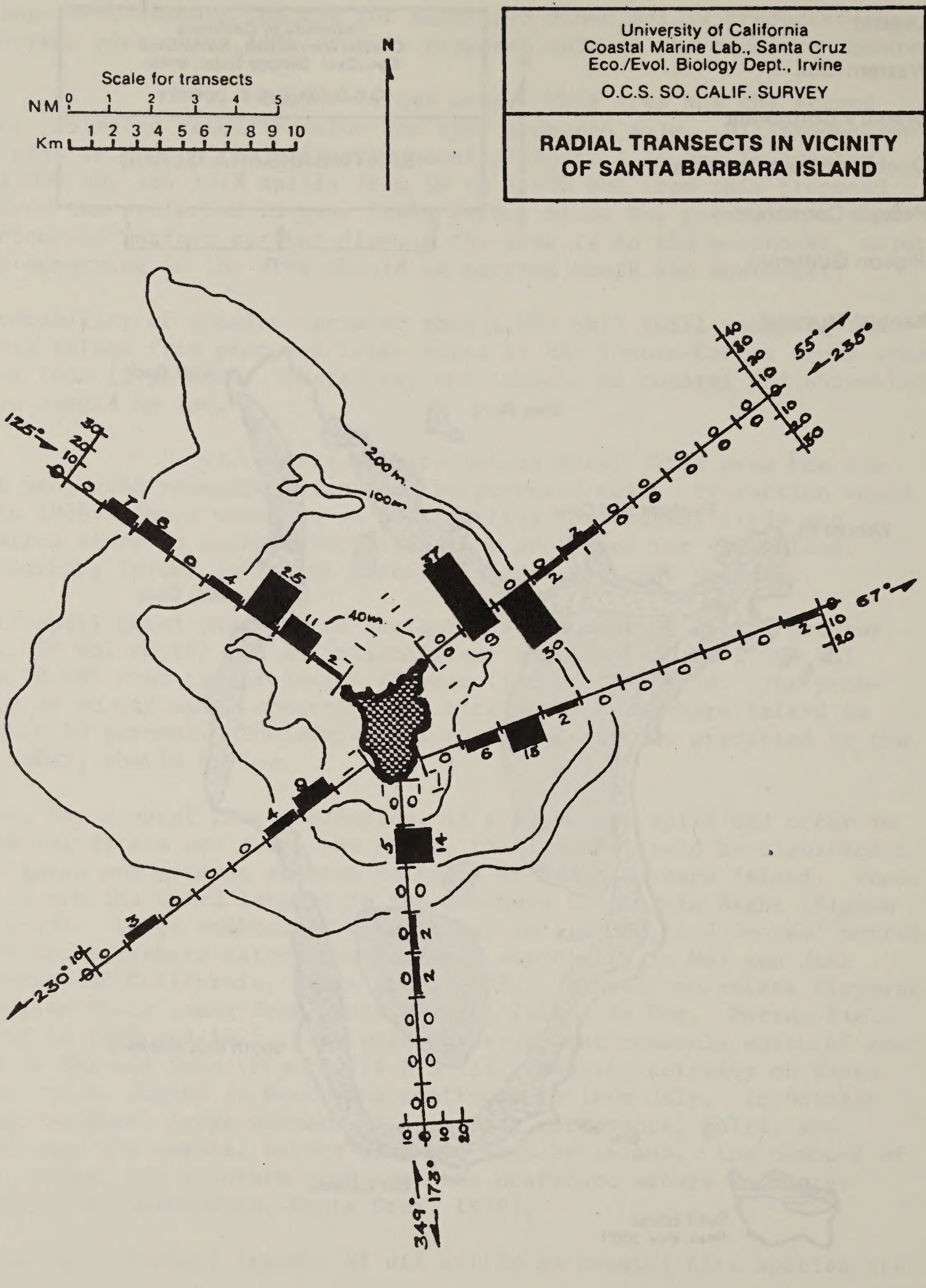


Figure III.E.3-11 Distribution of Xantus' Murrelet at Sea, April 1975. Numbers of Birds Sighted Per 1.85 (1 nm) on Indicated Headings. Source: University of California, Santa Cruz (1978).

d. Baja California Impacts: The only impacts on coastal and shorebird species off Baja California from this proposed sale would be from oil spills from proposed lease areas drifting down with the southeasterly-flowing California Current. Any spills reaching the waters off Baja would be greatly weathered, with most toxic fractions dissolved. The greatest number of potential spills from the southernmost lease areas are 1.14, predicted from the Tanner-Cortes area, and 0.17 predicted from the Dana Point-San Diego area. The oil spill model predicts very low (less than 5 or 10 percent) or negligible hits on shoreline segments in the Baja area from predicted spills in the Southern California Bight.

Any oil spills reaching the offshore islands with their large bird colonies would have the greatest impacts. These islands are Isla de Guadalupe, Isla San Benito, Isla Cedros, and Isla San Martin. Breeding on these islands generally occurs a few months before breeding in the Southern California Bight.

e. Central California Impacts: The only impact on shorebirds and coastal birds off central California from this proposed sale would be from oil spills from tankering oil from the Santa Barbara Channel, Santa Rosa and Tanner-Cortes Banks areas. The oil spill model predicts only 0.65 spills greater than 1,000 bbl for the Ventura-to-San Francisco tankering leg. The transportation phase would start in 1982, or 3 years after the proposed sale. Production for the proposed sale area would peak about 7 years after the proposed sale, or in 1986. The probability tables in POCS Reference Paper No. VI of central California predict probabilities of less than 6 percent for spills reaching central California land segments or resources from this proposed sale. Any spills along tankering leg T9, T10, and T11, shown in Figure 1-A of POCS Reference Paper No. VI, have the greatest probability for impacting shorebird and coastal bird populations.

Any spills hitting the major wetland habitats in the Pacific Flyway in central California would have significant impacts. These include Morro Bay, Elkhorn Slough, and San Francisco Bay. Spills hitting the Farallon Islands and Ano Nuevo Island could have significant impacts on the large coastal bird and seabird colonies.

f. Cumulative Impacts

i. Southern California Bight: The related projects considered for cumulative impacts in the area, along with the proposed action, are described in Section I.C.5. The greatest additional OCS oil and gas activity from existing and proposed Federal and State development will be in the Santa Barbara Channel, followed by the San Pedro Bay area and the Tanner-Cortes Banks area. The Santa Rosa and Santa Barbara Island areas will have associated OCS development from Federal Sale No. 35,

while the Dana Point-San Diego area will have no additional existing or projected OCS development except from this proposed sale. Increased tanker traffic in the Santa Barbara Channel and San Pedro Bay area will occur from existing imports of foreign crude, additional tankering of Alaskan crude through the Santa Barbara Channel to Long Beach, tankering of Elk Hills oil production from Port Hueneme to Long Beach and San Francisco through the Santa Barbara Channel, and LNG tankering, either in the Santa Barbara Channel or in the San Pedro area.

The additional, cumulative impacts on the shorebird and coastal bird populations from acute and chronic oil spills would produce the greatest effects. The oil spill model predicts a total of 19 oil spills greater than 1,000 bbl and 42.76 spills from 50 to 1,000 bbl from proposed Sale No. 48, existing Federal leases, and tankering of Alaskan and foreign crude oil for the entire Southern California Bight area. This does not include spills from existing and projected State tidelands development within 3 miles of the coast. The model predicts a total of 5 greater than 1,000 bbl spills from proposed Sale No. 48 development, 9.3 spills from existing Federal OCS leases, and 4.7 spills from Alaskan and foreign tankering. Oil spills from 50 to 1,000 bbl size are predicted as 11.15 spills from proposed Sale No. 48 development, and 31.61 spills from existing Federal leases and tankering of Alaskan and foreign crude. These projections assume a pipeline-tanker transportation mix for offshore production from proposed Sale No. 48 and existing Federal leases. If 100 percent of the oil production is tankered from proposed and existing Federal leases, the model predicts 11.6 greater than 1,000 bbl spills for the Bight versus 14.3 greater than 1,000 bbl spills from a mix of pipeline and tanker transportation.

As mentioned previously, the greatest potential for additional oil spill impacts on the shorebirds and coastal birds would be in the Santa Barbara Channel area (9.63 greater than 1,000 bbl spills and 18.78 50 to 1,000 bbl spills), followed by the San Pedro Bay area (4.96 greater than 1,000 bbl spills and 14.56 to 1,000 bbl spills) and the Santa Barbara Island area (0.09 greater than 1,000 bbl spills and 0.71 50 to 1,000 bbl spills). The cumulative oil spill impacts in the Santa Rosa and Dana Point-San Diego Bay areas should be low. All of these predicted spills are totals projected over the expected 25-year life of the fields for the most probable resource estimates.

For the Santa Barbara Channel area, probabilities for major spills hitting the Northern Channel Islands are greater for existing leases than for the proposed leases. Also, the predicted number of oil spills from existing leases is greater than from proposed sale areas (4.66 to 3.10) for the entire Channel. Projected Alaskan crude tankering could add another 1.87 greater than 1,000 bbl spills, for a cumulative major spill total of 9.63. Cumulative spills from 50 to 1,000 bbl could add another 18.78 incidents. The significance of long-range impacts associated with

this increased oil spillage and development activity in the Channel are unknown. For a worst case projection, it could lead to reduced species diversity by eliminating some marginal bird species and decreased abundance of the coastal bird populations.

For the San Pedro area, the impacts of a major spill would be similar to the Santa Barbara Channel for any spill hitting and getting into the critical shorebird habitats in Anaheim Bay, Bolsa Chica Bay, and Upper Newport Bay.

For the Santa Barbara Island area, although the number of predicted cumulative oil spills is low, the importance of the island as a bird breeding habitat suggests that any major oil spills hitting the area could have significant impacts. The cumulative effects would be similar to those previously discussed under the Santa Barbara Island impact discussion.

The chronic, long-term effects of additional oil spills from the proposed and related actions are unknown. Overall, the long-term, chronic additions of hydrocarbons to the marine environment in the Bight from the proposed and related actions must be put in perspective to the large daily oil seepage from natural seeps over thousands of years (40 to 670 bbl/day estimated for the Santa Barbara Channel alone), the large daily oil and grease discharges from land sewer outfalls (6 to 596 bbl/day, estimated for each of 6 major outfalls), and oil runoff from rivers, creaks and drains from land (1 to 27 bbl/day from 14 major sources) (Section III.A.4.).

The cumulative, long-term effects of human disturbance activity from increased OCS development in the Santa Barbara Channel, Tanner-Cortes Banks, and San Pedro Bay area are unknown. Tanker traffic and increased OCS development activity will be heaviest in the Santa Barbara Channel. The Channel is heavily used by coastal birds and nesting seabirds. The San Pedro Bay area would receive the next highest level of cumulative impacts from increased OCS development activity and increased tanker traffic from Alaskan and foreign oil imports.

ii. Baja California: The only additional, cumulative impacts on coastal birds and shorebirds in Baja California would result from additional oil spills reaching the area for the cumulative projects discussed in Section I. Any spills reaching the Baja California waters would generally remain offshore and be in a dispersed, weathered state. The impacts on coastal birds and shorebirds should be low.

iii. Central California: Increased oil spills from tanker traffic from Alaskan crude and cumulative oil production from the Santa Barbara Channel and the Tanner-Cortes Banks areas would increase spill probabilities along tanker legs T9 through T12 and T1 through T4. Impacts on coastal and shorebird populations and colonies could be

significant if they reached the sensitive habitats discussed previously. Some loss of shorebird habitat would occur if a proposed LNG facility is constructed at Point Conception. Long-term, chronic impacts on coastal and shorebird populations from oil spills associated with increased tanker traffic along the coast are unknown.

Summary of Impacts. Most impacts of the proposed lease sale would take place in the Southern California Bight (SCB). The most significant impact as a result of the lease sale to coastal and seabirds would be the 5.0 oil spills, greater than 1,000 bbl, that are expected to occur in the SCB. The direct impact from the expected number of oil spills is not believed able to cause the extinction of any coastal birds or seabird species found in the SCB. With a major spill, population levels could be depressed but recovery to a pre-oil spill population level is assumable. The long-term toxic and sublethal effects from oil could cause the most significant impacts on coastal birds and seabirds. The existence and/or magnitude of these effects are, as yet, unknown.

4. Impact on Wildlife: This section discusses only impacts upon coastal terrestrial wildlife. For a complete discussion of impacts on marine mammals see Section III.C.1.e. Impacts on threatened or endangered species are discussed in Section III.E.5.

a. Impacts on Wildlife of the Southern California Bight

i. Santa Barbara Channel Area Impacts: The impact on terrestrial wildlife would be either direct through habitat encroachment or secondary through potential oil spill contamination of food sources (terrestrial and beach source).

Through the beach vegetation and carrion links in the food web, it is possible that oil pollution could affect terrestrial wildlife which either constantly or intermittently use the beaches. Intermittently, deer, cattle, goats, sheep and other foragers utilize beach and intertidal zone plants exclusively and would thus be vulnerable to the threat. The island fox utilizes littoral zones extensively for food gathering.

This ingestion of oil-covered carrion by foxes, skunks, and shrews would result in petroleum hydrocarbons being assimilated directly at the top of the food chain; however, the relative toxicity of crude oil to these mammals is not known.

The impact on beach-utilizing mammals of oil hydrocarbons that have become entrained in the marine ecosystem from chronic low-level sources is unknown.

The direct impact of onshore construction on the smallest mammals (shrews, mice, ground squirrels, and rabbits) would be of limited magnitude (only about 12 ha (30 acres) of direct land requirements are anticipated due to the proposed action). Only those individual animals having home ranges within or overlapping the actual construction would be either destroyed or displaced. This zone would be narrow enough that the initial disturbance should extend little beyond it. There would be a definite alteration of habitat within the construction zone. The net change from the standpoint of value to the food chain should be minimal. Wherever vegetative cover is not replaced relatively quickly by favorable cover the net change would be greater.

Any impact occurring within a construction zone should be well dissipated just outside. This is interpreted to mean that there

should be little measurable impact on the total system stemming from impact on small mammal species. Much the same can be said for the larger rodents and small predators. There should be little adverse direct or indirect impact on these species.

There is potential for direct and indirect impact on both the very small mammals and the larger rodents and small predators during any pipeline operation.

There would be direct, adverse, short-term impacts on small mammals anywhere that an oil spill reached land. The impact would depend on the place, the habitat, and the season of the year. It might range from minute to severe depending on the circumstances. There is insufficient information available to evaluate the long-term and indirect effects of oil spills upon small mammals.

Some mammals could die from ingesting oil from contaminated pelage while grooming (Alaska, State of, 1971, p. 63). Scavengers such as foxes and skunks, could occasionally eat oil-killed animals, thereby ingesting petroleum.

ii. San Pedro Bay Area Impacts: The only direct impacts upon terrestrial wildlife in this area would occur as a result of onshore facility construction. Such impacts have just been described for the Santa Barbara Area and would affect as much as 12 ha (30 acres). Additional secondary and indirect impacts as a result of the proposal would be similar to those described for the Santa Barbara Area.

iii. Dana Point-San Diego Area Impact: No onshore construction as a result of the proposed action is expected within this area. Therefore direct impacts upon terrestrial wildlife would occur only as the result of an oil spill reaching shore and destroying wildlife habitat or on the wildlife itself. Secondary impacts upon wildlife of the area may result from changes in air quality. Degradation of wildlife habitat resulting from poor air quality may result in impacting wildlife through loss of food supply or cover.

iv. Santa Rosa Area Impact: Terrestrial wildlife on the northern Channel Islands may be impacted through oil spills or changes in air quality resulting from the proposed action. For a more complete discussion see Section III.C.1.i.

v. Tanner-Cortes Area Impacts: Impacts on terrestrial wildlife as a result of the proposed action in this area would occur only as a result of possible oil spills or changes in air quality, however, those are expected to be minimal.

vi. Santa Barbara Island Area Impacts: Impacts upon terrestrial wildlife of Santa Barbara Island area are expected to be minimal. Probably the greatest impact would occur from an offshore oil spill impinging upon Santa Barbara Island or any of the other Channel Islands.

b. Impact on Wildlife of Northern Baja California: The impact on wildlife of Northern Baja California would be expected to be secondary in nature, through possible oil contamination of the shoreline area and subsequently, food sources.

The mechanisms by which such contamination can affect wildlife have been discussed. Since no onshore facilities are to be built in Baja, no direct habitat encroachment is expected.

c. Impact on Wildlife of Central California: Since this region (Point Conception to Point Reyes) is expected to receive only tankering traffic from the proposed lease sale, impacts resulting from accidental spills are expected. The actual extent to which such a spill would impact terrestrial wildlife depends upon the size of the spill, sea conditions and season of the year.

Many of the secondary impacts of oil spills have been discussed in the section for Southern California and will not be dealt with again here.

d. Cumulative Impacts and Summary: Cumulative impacts upon terrestrial wildlife due to the proposed action would result directly from the utilization of approximately 24 ha (60 acres) of land as onshore facilities or staging areas. If these sites were to occupy the few areas of wildlife habitat remaining in the Southern California area it would serve to further diminish this type of habitat. Perhaps the greatest danger to terrestrial wildlife would be from oil spills fouling the shoreline and the wildlife habitat available there. Another significant impact may result from the cumulative effects of changes in air quality as a result of the proposed action. This type of impact would be mainly secondary in nature by perhaps destroying or otherwise impeding the growth of wildlife habitat. However, it is very probable that the proposed action will not have long-term or significant effects upon the population levels and species composition of the terrestrial wildlife in the SCB, northern Baja California or central California.

5. Impacts on Endangered and Threatened Species: The rare, threatened and endangered species, which may be impacted by proposed Sale No. 48, all live offshore, along the shore, or spend much time offshore. For these reasons, impacts upon them are treated in Section III.C.1.f, Impacts Offshore.

An exception is where the proposed pipelines come ashore. However, to consolidate this discussion, the impacts are also included in Section III.C.1.f.

6. Impacts on Unique Biological Environments: All the unique biological environments, included in this ES, are either offshore or along the shore. Therefore, they are discussed in the Offshore Impacts Section (III.C.1.j).

7. Impact on Water Quality and Water Supply: Changes in the population and industry as a result of the proposed Lease Sale No. 48 or Cumulative Projects (described in Section I) would change the demand on existing municipal wastewater treatment facilities. This increased demand on municipal treatment facilities will be in excess of the changes that will occur due to continued population and industrial growth. With the exception of Ventura and Santa Barbara Counties, no coastal county is expected to have a significant increase in demand for domestic (residential) wastewater treatment resulting from the proposed oil and gas lease sale or cumulative projects. Increases in industrial wastewater treatment as a result of the proposed oil and gas lease sale is expected to be less than 1 percent; this is considered to be an insignificant increase.

An estimate of the deterioration of water quality or an increase in municipal wastewater treatment, during peak oil production years (approximately 1986), can be found by estimating the increase in sewage loads as a function of population. Although domestic sewage from residential and commercial areas are the major part of the municipal wastewaters, varying percentages of the wastewaters treated by a municipal treatment plant may be industrial wastewaters that were discharged into a municipal treatment plant's wastewater system. For this reason, the percent of domestic wastewater for a municipal treatment plant will depend on the area's industry. The domestic wastewater loads for the two largest municipal treatment plants in Southern California (Los Angeles County Sanitation Districts, JWPCP, and the City of Los Angeles Bureau of Sanitation Hyperion Plant) are 65 to 90 percent of their total wastewater loads. The JWPCP has a domestic waste load of approximately 85 to 90 percent of the total plant's waste treatment load; and the Hyperion Plant has a domestic waste load of approximately 65 to 70 percent of their total plant's waste treatment load.

The projected municipal wastewater flow for five coastal counties (Santa Barbara, Ventura, Los Angeles, Orange, and San Diego) in Southern California are shown in Table III.E.7-1. The flow information given in this table is an estimate and therefore, only shows what the approximate flow may be. Also shown in this table are the approximate projected flow capacities for some of the counties. The projected percent increases of wastewater treatment resulting from Sale No. 48 or cumulative projects (including Sale No. 48) are also shown in Table III.E.7-1. The projected increases of wastewater treatment were based on population projection from the Curtis Harris Economic Model (Pacific OCS Reference Paper No. IV).

Information found in Table III.E.7-1 shows that Los Angeles County, Orange County and San Diego County may have minor demand increases in their wastewater treatment capacity, while Santa Barbara and Ventura

Table III.E.7-1

DOMESTIC WASTE TREATMENT DEMAND AND ESTIMATED DEMAND INCREASES

	1975		1985[c]			
					Estimated Percent Flow Increase	
County[a]	Flow (mgd)	Capacity (mgd)	Flow (mgd)	Capacity (mgd)	Resulting from Sale No. 48	Resulting from Sale No. 48 & Other Cumulative Projects
Santa Barbara[b]	37: 18-Ocean outfall, 10-beneficial reuse, 8-septic		44: 21-Ocean outfall, 16-beneficial reuse, 7-septic		1.1	14
Ventura	43		62	71	3	10
Los Angeles	887	958	962	908	0.13	0.33
Orange	170	184	215	215	0.01	0.33
San Diego	130	150	212	240	0.15	0.15

[a]Source: Santa Barbara County-Santa Barbara County Water Agency.
Ventura County-Los Angeles Regional Water Quality Control Board.
Los Angeles County-Los Angeles Regional Water Quality Control Board.
Orange County-Orange County Sanitation District.
San Diego County-San Diego Regional Water Quality Sanitation District.

[b]1985 values were interpolated between the years 1975 and 2000.

[c]Peak demand period for Sale No. 48.

Counties have moderate increases for their wastewater treatment capacity resulting from Sale No. 48 and significant increases for wastewater treatment capacity resulting from Sale No. 48 and other cumulative projects.

The Environmental Protection Agency's Strategic Environmental Assessment System (SEAS) is discussed in Pacific OCS Reference Paper No. IV. This model, which is based on the Curtis Harris Economic Model, was designed to estimate water pollution emission changes from changes in the levels of industrial and commercial activities and population fluctuatons resulting from the proposed oil and gas lease sale or other cumulative projects. The essential findings of this study are summarized in Tables III.E.7-2 and III.E.7-3. Table III.E.7-2 shows the percent increase in water pollution from Sale No. 48. Table III.E.7-3 shows the percent increase in water pollution resulting from Sale No. 48 and all other cumulative projects. With the exception of dissolved solids, over 99 percent of the water pollution shown in Tables III.E.7-2 and III.E.7-3 are contributed from municipal sewage. Increase in dissolved solids is a result of electric utilities.

In addition to the increased demand on wastewater treatment facilities, as a result of changes in population and industry resulting from Sale No. 48 or other projects, demand for water will be increased. As the population increases, the number of gallons per capita will decrease. Table III.E.7-4 shows the number of gallons of water per capita in 1975 and the projected number of gallons of water per capita in 1985. From the estimated percent population demand increase shown in Table III.E.7-4, the reduced gallons of water per capita can be determined. For example, if the population or population demand increased by 100 percent, the gallons of water available per capita would be reduced by 50 percent. From the information shown in Table III.E.7-4 there should not be any noticeable reduction in available water as a result of Sale No. 48 or other cumulative projects including Sale No. 48 in Los Angeles, Orange, and San Diego Counties. There may be a moderate reduction in the available water in Ventura and Santa Barbara Counties as a result of Sale No. 48; additionally available water may be significantly reduced as the result of Sale No. 48 and other cumulative projects.

In Santa Barbara County and Ventura County, the water demand figures shown in Table III.E.7-4 are higher than the other coastal counties because of the smaller populations and high agricultural needs. The Santa Barbara County Water Agency (1977) shows the applied water demand (water pumped to home or agricultural field) for the year 1975 to be 274,400 acre ft. (213,400 acre ft, net demand: applied water demand minus returns to water basin): and the extrapolated 1985 applied water demand to be 291,350 acre ft. (226,581 acre ft, net demand). The firm water supply (ground and surface water) anticipated for the county is 172,400 acre ft. (Lawrance, 1976). The firm water supply compared with

Table III.E.7-2

PERCENT INCREASES IN WATER POLLUTION RELATIVE TO 1975 FROM ONSHORE ECONOMIC ACTIVITY RESULTING FROM MOST PROBABLE OCS (SALE NO. 48) DEVELOPMENT WITH PIPELINE AND ALL OTHER CUMULATIVE PROJECTS[a]

	1980	1985	1990	1995	2000
County: Los Angeles					
Biochemical Oxygen Demand	0.078	0.225	0.245	0.176	0.177
Suspended Solids	0.078	0.225	0.245	0.176	0.177
Dissolved Solids[b]	0.000	0.140	0.200	0.190	0.190
Nutrients - Nitrates	0.079	0.227	0.246	0.176	0.178
Nutrients - Phosphates	0.079	0.227	0.246	0.176	0.178
County: Orange, Ca					
Biochemical Oxygen Demand	0.577	0.607	0.566	0.493	0.397
Suspended Solids	0.577	0.607	0.566	0.493	0.397
Dissolved Solids	0.000	80.564[c]	65.13	52.60	43.37
Nutrients - Nitrates	0.577	0.607	0.566	0.493	0.397
Nutrients - Phosphates	0.577	0.607	0.566	0.492	0.396
County: San Diego, Ca					
Biochemical Oxygen Demand	-0.016	0.138	0.097	0.034	0.020
Suspended Solids	-0.016	0.138	0.097	0.034	0.020
Dissolved Solids	0.000	0.0	0.0	0.0	-0.050
Nutrients - Nitrates	-0.016	0.138	0.097	0.034	0.020
Nutrients - Phosphates	-0.016	0.138	0.097	0.034	0.020
County: Santa Barbara, Ca					
Biochemical Oxygen Demand	4.738	11.331	12.068	8.741	7.566
Suspended Solids	4.744	11.344	12.078	8.749	7.572
Dissolved Solids	0.0	0.0	0.0	0.0	0.0
Nutrients - Nitrates	4.757	10.301	11.138	7.892	6.815
Nutrients - Phosphates	4.757	10.301	11.138	7.892	6.815
County: Ventura, Ca					
Biochemical Oxygen Demand	0.503	3.249	4.119	2.572	1.333
Suspended Solids	0.503	3.250	4.121	2.573	1.332
Dissolved Solids	0.000	1.703	2.245	1.269	0.876
Nutrients - Nitrates	0.505	3.257	4.129	2.577	1.333
Nutrients - Phosphates	0.505	3.257	4.129	2.577	1.333

[a]Source: Pacific OCS Reference Paper No. IV.
[b]The only sources of dissolved solids considered in this table are from Electric Utilities and other miscellaneous industries.
[c]Increase due to addition to San Onofre Nuclear Power Plant.

Table III.E.7-3

PERCENT INCREASES IN WATER POLLUTION RELATIVE TO 1975 FROM ONSHORE ECONOMIC ACTIVITY RESULTING FROM MOST PROBABLE OCS DEVELOPMENT WITH PIPELINE

	1980	1985	1990	1995	2000
County: Los Angeles, Ca					
Biochemical Oxygen Demand	0.004	0.100	0.111	0.083	0.078
Suspended Solids	0.004	0.100	0.111	0.083	0.079
Dissolved Solids	0.000	0.070	0.110	0.090	0.080
Nutrients - Nitrates	0.004	0.101	0.112	0.083	0.079
Nutrients - Phosphates	0.004	0.101	0.112	0.083	0.079
County: Orange, Ca					
Biochemical Oxygen Demand	-0.001	0.012	-0.001	-0.010	-0.032
Suspended Solids	-0.001	0.011	-0.001	-0.010	-0.032
Dissolved Solids	0.000	0.000	0.000	0.000	0.000
Nutrients - Nitrates	-0.000	0.012	-0.002	-0.009	-0.032
Nutrients - Phosphates	-0.000	0.012	-.002	-0.010	-0.032
County: Santa Barbara, Ca					
Biochemical Oxygen Demand	0.103	0.878	0.633	0.331	0.307
Suspended Solids	0.104	0.879	0.632	0.331	0.307
Dissolved Solids	0.0	0.0	0.0	0.0	0.0
Nutrients - Nitrates	0.104	0.881	0.633	0.332	0.307
Nutrients - Phosphates	0.104	0.881	0.633	0.332	0.307
County: San Diego, Ca					
Biochemical Oxygen Demand	0.009	0.169	0.177	0.156	0.168
Suspended Solids	0.009	0.169	0.177	0.156	0.168
Dissolved Solids	0.0	0.190	0.150	0.060	0.050
Nutrients - Nitrates	0.009	0.169	0.177	0.156	0.168
Nutrients - Phosphates	0.009	0.169	0.177	-.156	0.168
County: Ventura, Ca					
Biochemical Oxygen Demand	0.187	2.481	3.496	1.590	1.399
Suspended Solids	0.188	2.481	3.498	1.588	1.400
Dissolved Solids	0.000	1.434	1.935	1.002	0.701
Nutrients - Nitrates	0.189	2.486	3.505	1.590	1.402
Nutrients - Phosphates	0.189	2.486	3.505	1.590	1.402

[a]Source: Pacific OCS Reference Paper No. 4.
[b]The only sources of dissolved solids considered in this table are from Electric utilities and other miscellaneous industries.

Table III.E.7-4

CURRENT AND PROJECTED WATER DEMANDS AND ESTIMATED POPULATION DEMAND INCREASE

County[a]	Gallons per Capita		Estimated Percent Population Demand Increase	
	1975	1985[b]	Resulting from Sale No. 48	Resulting from Sale No. 48 and Other Cumulative Projects
Santa Barbara[c] --	871	820	1.1	14
Ventura[d] (Santa Clara Basin)	648	569	3	10
Los Angeles[d] (Los Angeles Basin)	191	204	0.13	0.33
Orange[d] (Santa Ana Basin)	589	339	0.01	0.33
San Diego[d] (San Diego Basin)	300	326	0.15	0.15

[a]Information for each county is based on the respective water basins, not county limits.
[b]Peak demand period for Sale No. 48.
[c]Source: Water demands-Santa Barbara Water Agency, 1977. Estimated population-Curtis Harris Model (Pacific OCS Reference Paper No. IV).
[d]Source: Abstracted from information obtained from the California Department of Water Resources.

the net water demand shows that a significant deficient water demand exists. The majority of the water demand is brought about by the water demand in the northern region of the county. To mitigate deficient water demand needs, Santa Barbara presently has a water moratorium in the southern part of the county that restricts the expansion of the present water system; and ground water overdrafting has been reduced by restricting the development of new water wells.

Ventura County's estimated 1975 water demand is 360,800 acre ft. and the 1985 water demand is projected to be 408,400 acre ft. (personal communication, California Department of Water Resources). The projected supply of water for this county is not known. Because the adequacy of the projected water supply to meet projected water needs for this county is not known, the future water demand deficient is not known. With several sources of water in Ventura County, the significance of any increased water demand, due to Sale No. 48 or other projects, will depend on the region within the county the increased population demand exists.

In conclusion, the proposed Lease Sale No. 48 or other cumulative projects will increase the demand on existing wastewater treatment facilities. With the exception of electrical utilities, industry will account for less than 1 percent of the increased water pollution while municipal sewage will account for over 99 percent of the estimated increase in water pollution. Los Angeles, Orange and San Diego Counties are expected to have an insignificant increase in their municipal sewage waste loads as a result of Sale No. 48 or other cumulative projects, including Sale No. 48. Santa Barbara and Ventura Counties are expected to have moderate increases of their municipal sewage waste loads as a reuslt of Sale No. 48 and significant increases in their municipal sewage waste loads as a result of Sale No. 48 and other cumulative projects. The full impact of the projected increased municipal sewage waste loads for Ventura and Santa Barbara Counties will depend on the areas within each county that population densities significantly increase and each respective area's method of domestic sewage waste treatment.

County and city municipal sanitation agencies are currently planning projected wastewater treatment needs to assure compliance with the "Federal Water Pollution Control Act Amendments of 1972" (Public Law 92-500) and the subsequent 1977 Clean Water Act Amendments. The Santa Barbara and Ventura Counties projected municipal wastewater treatment facilities ability to maintain clean water standards with the added wasteloads resulting from the proposed sale or other projects is not unequivocally known. Both Santa Barbara and Ventura Counties should be able to maintain their projected water quality standards with the increased wastewater flows of 1 percent in Santa Barbara County and 3 percent in Ventura County resulting from Sale No. 48. The ability of Santa Barbara County or Ventura County to maintain their projected water

quality standards with increased wastewater flows of 14 percent in Santa Barbara County and 10 percent in Ventura County, as a result of all cumulative projects including Sale No. 48 is questionable.

The increased water demand resulting from the proposed lease sale or other projects is estimated to be insignificant in Los Angeles, Orange, and San Diego Counties. The increased water demand resulting from the proposed sale is estimated to be moderate for Santa Barbara and Ventura Counties. The water demand for both of these counties may be significantly increased as a result of the proposed lease sale and other projects. Water moratorium restriction existing in Santa Barbara County may curtail future development.

8. Impact on Regional Land Use

a. Impacts on Southern California Bight: Land use impacts expected to occur as a result of proposed Sale No. 48 will be discussed, based on the most probable development scenario in Chapter I. Impacts using other scenarios will be discussed in the Alternatives section. It is assumed that no new refineries, treatment facilities, terminal facilities, or onshore pipeline acreage will be required. The only new acreage required for facilities as a result of the proposed sale would be 24 ha (60 acres) for four new operations bases (includes helicopter pads, warehouse and office space, dockage, etc.). Each base would require 6 ha (15 acres) of space. Two bases would be located in the Santa Barbara Channel area of the Ventura-Santa Barbara County coast and two in the Los Angeles-Long Beach Harbor area. All of the facilities would be subject to Federal, State, and local regulations, land use plans, policies or controls. If the onshore bases are located in areas where land uses are compatible and space is available, no significant adverse impacts should result. Conversely, if facilities were allowed in areas where uses were not compatible, adverse impacts could occur. The California Coastal Zone Management program encourages industrial facilities to locate or expand within existing sites unless they cannot feasibly be accommodated. Even then, there are provisions which would allow for development if: 1) alternative locations are infeasible or more environmentally damaging; 2) to do otherwise would adversely affect the public welfare; 3) adverse environmental effects are mitigated to the maximum extent feasible. Coastal development permits will be subject to approval by the Coastal Commission until local Coastal Plans and/or Port Master Plans are completed and approved. Port Master Plans will be prepared for the Ports of Los Angeles, Long Beach, Hueneme and San Diego. All other areas would be prepared by the Commission or local governments. Therefore, since the facilities will probably be sited in port areas with existing industrial-zoned areas, we do not anticipate any significant change in land use. For a discussion of potential competition for harbor space between commercial fishing boats and recreational boats, see Sections III.C.7 and III.C.8, respectively.

Secondary Land Use Impacts. As indicated earlier in this section and as discussed in the economic analysis in Section III.E.15, industrially-induced land use is expected to be minimal. Land use as a result of Sale No. 48-induced population increases and economic changes will be impacted although the degree of impact varies considerably with each county.

Housing units in the five Southern California counties required as a result of OCS Sale No. 48 direct and induced activity is expected to be 12,203 during the peak year of 1986 (a population figure of 2.76/housing unit is used). This would represent a 0.29 percent increase over the 4,152,449 housing units available in 1975. Regionally, this would not

be a significant increase. However, in Ventura County, in order to maintain the 1975 average household size of 3.05/unit, an additional 5,763 units will be required. This would be a 3.99 percent increase over 1975 housing units and a 2.92 percent increase over the increased units projected for 1985 without Sale No. 48. See Table III.E.8-1 for a county by county breakdown.

Section III.E.15.c contains a detailed discussion concerning the effects of population increases on schools and hospitals. The results are: regionally, hospital and school facilities are adequate and will be able to meet the additional loads; on a county basis, Ventura County will require one new 60-bed hospital, one 37-room high school and four 20-room elementary schools.

Presently, there is no way to project the number of industrial and commercial activities that may be required to meet the increased employment and population needs, other than identifying those sectors in the Harris Model which show increases projected. However, this would only indicate that a particular sector is expanding, not how many facilities that sector would require. Therefore, in order to assess the potential impacts, we have chosen to look at the total land area required per new person into the area. For our purposes, we are using a consumptive rate of ½ acre per new person in the area (includes industrial and commercial acreage needed to employ new job holders, as well as commercial and residential acreage). (NERB, 1975b)

Using ½ acre then, in the peak year of 1986, Sale No. 48-induced land use acreage by county would be:

Santa Barbara County	-	1,749 acres
Ventura County	-	8,788 acres
Los Angeles County	-	4,978 acres
Orange County	-	124 acres
San Diego County	-	1,586 acres

These figures when compared to 1975 figures would represent increases of: 1.24 percent for Santa Barbara County; 3.99 percent for Ventura County; 0.14 percent for Los Angeles County; 0.01 percent for Orange County; and 0.20 percent for San Diego County.

Although Santa Barbara and Ventura Counties show a larger percentage increase in land use than the other counties, there should be enough developable land in each county to take care of the peak year acreage. The pressure to develop in non-urban areas would most likely be greater in Los Angeles County since a large portion of the existing urban areas are already developed.

Table III.E.8-1

PROJECTED HOUSING NEEDS DUE TO POPULATION INCREASES WITH AND WITHOUT SALE NO. 48

County	1975 Population[a]	1975 Housing Units Available[b]	% Vacancy[b]	Average Family Size Per House	1985 Population Projection[a]	Sale #48 Pop. Increase 1986[c]	Without #48 1985 Increased Units	Unit Increase from #48	Sale #48 % Increase Over 1985 Units	Sale #48 % Increase Over 1975 Units
Santa Barbara	281,100	103,051	3.1%	2.73	317,100	3,498	13,102	1,281	1.08%	1.24%
Ventura	440,700	144,468	4.9%	3.05	584,100	17,577	47,040	5,763	2.92	3.99%
Los Angeles	6,949,300	2,695,401	3.9%	2.57	7,377,900	9,956	175,377	3,874	0.13%	0.14%
Orange	1,712,600	607,630	2.3%	2.82	2,173,400	248	163,079	88	0.01%	0.01%
San Diego	1,594,100	601,899	5.1%	2.65	2,055,700	3,172	173,836	1,197	0.15%	0.20%
Total	10,977,800	4,152,449	Average 3.86%	2.76	12,508,200	34,451	572,434	12,203	0.26%	0.29%

[a]Table II.G.2.a-4 Total population of selected Southern California counties, projected, 1975-2000.
[b]Table II.G.1.a-2 Southern California Dwelling Units, 1975.
[c]Table III.E.14-1 Population Changes Due to Proposed Sale No. 48 Related Activity, Curtis Harris Model.

i. Summary: It is reasonable to assume, since there are a variety of land use controls available to handle facility siting and population associated land requirements, little adverse impact is anticipated.

Baja California Land Use Impacts. No significant land use impacts are anticipated.

Tankering Leg (Point Conception to Point Reyes). No significant land use impacts anticipated.

Cumulative Impacts. Cumulative impacts on land use will consider potential impacts from proposed Sale No. 48 added to those associated with Sale No. 35 and existing Santa Barbara Channel leases, and all other cumulative projects (Vaca Tar Sands, LNG. etc.).

Peak year employment and population figures shown in Table III.E.8-2 indicate that the largest increases will occur in Santa Barbara and Ventura counties. This would result in the need for 18,343 new housing units (a 12.7 percent increase over 1975 housing units) for Ventura County and 16,513 units (16 percent) for Santa Barbara County. The rest of the counties show less than a 1 percent increase. See Table III.E.8-3 for a county-by-county breakdown. Impacts on hospitals and school facilities would generally follow the same trend as housing units; Ventura and Santa Barbara counties would require the most classrooms and hospital beds. However, as Table III.E.8-4 indicates the majority of the classrooms and hospital beds required for Santa Barbara County are associated with population increases for all other cumulative projects while the increases for Ventura County are primarily due to Sale No. 48 and existing Santa Barbara leases and Sale No. 35-induced population increases. For a detailed discussion of population impacts on facilities, see Section III.E.15.c.

Direct cumulative land use acreage require as a result of OCS activity is expected to be around 400 to 500 acres which includes:

160-260 acres for operations bases (60 acres for Sale No. 48 and 100-200 acres projected for Sale No. 35.

37.4 acres for storage tanks (Sale No. 35)

3 onshore oil terminals	200 acres
1 onshore gas terminal	(Sale No. 35)

Total cumulative secondary land use impacts, using ½ acre per new person in the area, would be 68,349 acres for the five county area. This would be 51,123 acres over Sale No. 48 projections. Table III.E.8-5 shows that Ventura and Santa Barbara counties will receive the largest population-induced development pressures.

Table III.E.8-2

Area/County	Population (1986)				Employment (1985)		
	Sale No. 48	Sale No. 35 and S.B. Ch. Exist. Leases	All Other Cumulative LNG Pt. Con.	Total	Sale No. 48	Existing S.B. and Sale No. 35	Total
Los Angeles	9,956	3,303	10,945	24,204	1,512	1,765	3,277
Orange	248	136	7,994	8,378	75	118	193
San Diego	3,172	491	-574	3,089	178	234	412
Santa Barbara	3,498	6,398	35,185	45,081	565	2,749	3,314
Ventura	17,577	34,579	3,790	55,946	1,167	13,592	14,759
So. California	34,451	44,907	57,340	136,698	3,497	18,458	21,955

Table III.E.8-3

CUMULATIVE IMPACTS ON HOUSING UNITS FROM SALE NO. 48, EXISTING SANTA BARBARA LEASES AND SALE NO. 35, AND ALL OTHER CUMULATIVE PROJECTS (LNG ETC.)

County	1975 Housing Units Available	Average Family Size Per House	1985 Increased[a] Units Required Without Projects	1985 Units Required Due to Sale No. 48	1986 Units Required Due to S.B. & Sale No. 35	1986 Units Required Due to Other Projects	Total Sale No. 48, S.B. & Sale No. 35, All Other Cumulative (LNG etc.)	% Increase (Cumulative Units) Over 1975 Units
Santa Barbara	103,051	2.73	13,102	1,281	2,344	12,888	16,513	16.0%
Ventura	144,468	3.05	47,040	5,763	11,337	1,243	18,343	12.7%
Los Angeles	2,695,401	2.57	175,377	3,874	1,285	4,259	9,418	0.3%
Orange	607,630	2.82	163,079	88	48	2,834	2,970	0.5%
San Diego	601,899	2.65	173,836	1,197	185	-217	1,165	0.2%
Total	4,152,449		572.434	12,203	15,199	21,007	48,409	1.2%

[a]Using projected 1985 population figures from California Department of Finance, 1977.

Table III.E.8-4

PROJECTED NEW CLASSROOMS AND HOSPITAL BEDS REQUIRED BY INCREASED ENROLLMENT DUE TO SALE NO. 48 AND CUMULATIVE PROJECTS, 1986

	Population Increase	No. of New Students[a]	No. of New Classrooms Needed[b]	No. of Hospital Beds Needed[c]
1986 Sale No. 48				
Santa Barbara	3,498	700	23	16
Ventura	17,577	3,515	117	60
Los Angeles	9,956	1,991	66	56
Orange	248	50	2	1
San Diego	3,172	634	21	12
1986 Cumulative Sale No. 35 & S.B. Channel Leases				
Santa Barbara	6,398	1,280	43	29
Ventura	34,579	6,916	231	118
Los Angeles	3,303	661	22	19
Orange	136	27	1	1
San Diego	491	98	3	2
1986 All Other Cumulatives (LNG etc.)				
Santa Barbara	35,185	7,037	235	162
Ventura	3,790	758	25	13
Los Angeles	10,945	2,189	73	62
Orange	7,994	1,599	53	42
San Diego	-574	-115	-4	-2
Total				
Santa Barbara	45,081	9,016	301	207
Ventura	55,946	11,189	373	190
Los Angeles	24,204	4,840	161	137
Orange	8,378	1,676	56	44
San Diego	3,089	618	20	11

[a] Student population = 20% of population.
[b] Average classroom assumed to be 30 pupils.
[c] Adapted from Table II.G.2.d-6.

Table III.E.8-5

CUMULATIVE SECONDARY LAND USE ACREAGE REQUIRED[a] BY POPULATION CHANGES BY COUNTY (1986 PEAK YEAR)

County	1986 Population				Acreage Required			
	Sale No. 48	Sale No. 35 and S.B. Channel Leases	All Other Cumulative (LNG etc.)	Total	Sale No. 48	Sale No. 35 and S.B. Channel	All Others (LNG etc.)	Total
Santa Barbara County	3,498	6,398	35,185	45,081	1,749	3,199	17,592	22,540
Ventura County	17,577	34,579	3,790	55,946	8,789	17,289	1,895	27,973
Los Angeles County	9,956	3,303	10,945	24,204	4,978	1,652	5,472	12,102
Orange County	248	136	7,994	8,378	124	68	3,997	4,189
San Diego County	3,172	491	-574	3,089	1,586	246	-287	1,545
Total Southern California	34,451	44,907	57,340	136,698	17,226	22,454	28,669	68,349

[a] ½ acre/person.

9. Impact on Regional Transportation

a. Onshore Pipeline System: Proposed Sale No. 48 development and production activities could impact the existing onshore pipeline systems. Proposed offshore oil and gas pipelines could connect with the existing onshore oil and gas processing facilities at the Ventura or Long Beach area. In addition, the connecting pipelines between proposed offshore pipelines and processing facilities could require modifications.

Offshore gas pipelines in the San Diego area could connect with an existing onshore gas pipeline which is owned by the San Diego Gas and Electric Company.

There should be no impacts on existing pipeline systems in the San Francisco Bay area.

Cumulative impacts on the existing onshore pipeline system would probably be only from the combined Sale No. 48 and existing Federal lease projects in the Ventura and Long Beach areas. For these two projects, the modifications would probably be made to the existing oil and gas processing facilities and the existing connecting pipelines.

b. General: The proposed Sale No. 48 exploratory and development phases could impact the railroads, highways, and airports in the area near Ventura, Long Beach, and San Diego. There would probably be an increase in rail and highway traffic for transporting materials and equipment to meet the demands of various offshore operations. The increase in loads should be within the current transportation systems' capabilities.

Airports near the above three areas could have a moderate increase in helicopter traffic. Helicopters are a common method of transportation for transporting personnel and light equipment to and from offshore structures.

Cumulative impacts on the railroads, highways, and airports from proposed Sale No. 48, existing Federal leases and other projects would probably increase the demands in these transportation systems.

10. Solid Waste

a. Impacts on Southern California Bight

i. Offshore: Pacific OCS Order No. 7 requires that, drill cuttings, sand and other solids containing oil shall not be disposed of into the ocean waters; also that mud containers and other solid materials, shall be transported to shore for disposal.

Based on 2.04 kg (4.5 pounds) of solid waste/person/day (estimates range from 1.50 kg to 2.72 kg (3.3 to 6 pounds), Snyder, 1974; CEQ, 1974) and 1985 peak employment figures of 3,497, the maximum waste generated offshore in the Southern California OCS as a result of the proposal, during peak production years, would be approximately 2,610.8 MT/year (2,871.9 tons/year). This is equivalent to less than 9 percent of the present Los Angeles County daily waste loads. If all the waste was disposed of in Santa Barbara County, it would represent an additional increase of less than 1 percent of the annual waste load (Table III.E.10-1). At times other than peak production years and considering normal waste load distribution, increases would be even less significant.

The other source of offshore solid waste resulting from this proposal would be that generated during an oil spill cleanup operation. This would include the oil itself and any oil soaked debris (oil impregnated sand, wood, straw, branches, seaweed, etc.). Normally the oil can be recycled or rerefined and the debris would be used for landfill. The amount of this material would be dependent on individual spills and the particular area involved. There are numerous county operated landfill sites located in the Southern California area (Table II.G.1.e-1), however, not all of the sites are Class I (no restrictions on acceptable material including oil and oil soaked materials). Before oil and oil soaked material can be disposed of at a Class I site, a permit must be obtained from the local solid waste enforcement agency, the State Department of Health and Waste Discharge Requirements from the Regional Water Quality Control Board must be obtained. The following is a list of Class I sites identified in contingency response plans for Southern California.

Los Angeles County	Ventura County
Landfill No. 1, Palos Verdes	Simi Valley Sanitary Landfill, Simi Valley
Landfill No. 5, Calabasas	Refuse Disposal Site No. 2, Simi Valley
B.K.K. Company, West Covina	Casmalia Landfill, Casmalia
	J & J Disposal, Oxnard

San Diego

Otay Landfill, Otay

Most of these sites can handle smaller spills. However, in the event of a major spill reaching shore, serious impacts could result. The Battelle Report No. CG-D-56-74 states when more than 1,000,000 to 2,000,000 gallons

of oil are recovered, refineries, rerefineries, landfills, and incinerators would be unable to accept the oil as fast as it is delivered. This was the case with 1969 Santa Barbara spill. Additional disposal methods become necessary, such as landspreading and burial, which cause additional impacts. Burial means more land would be permanently dedicated to disposal indefinitely, and oil would remain undegraded for longer periods increasing the long-term pollution potential. Landspreading would not require long-term use of the land. It could however, increase air pollution through volatilization of the oil.

ii. Onshore: Impacts on existing solid waste management systems as a result of the proposed sale are based on an expected 1986 peak year population increase (projected by Harris Model) and on the per capita solid waste tonnage figures presented in Table II.G.1.e-1, for each county. The total projected population increase, due to Proposed Sale No. 48, of 34,451 for the five county area would represent less than a 1 percent (0.31 %) increase over the 1975 population of 10,977,800.

Figures taken from the Harris Model indicate that peak year population increases will occur in 1986. The population increases, by county, due to Proposed Sale No. 48 related activity are as follows:

County		
Santa Barbara	3,498	
Ventura	17,577	
Los Angeles	9,956	
San Diego	3,172	
	34,451	Total

Table III.E.10-2 provides a breakdown, by county, of 1986 solid waste generated by the Proposed Sale No. 48 related population increases and the percent increase over 1985 volumes. Ventura County, with the largest population increase, shows about a 3-percent increase (3.01%). At times other than the peak population year, volumes will be considerably less. Therefore, it is reasonable to assume that additional waste loads generated as a result of this proposal could be handled by existing landfill sites and impacts would be negligible. In terms of collection and transportation services, there could be an impact, depending on where the county population increases are. Table III.E.10-3 shows that Ventura and Santa Barbara counties will receive the most impact (70 and 66 truckloads of solid waste generated/week, respectively,) with the three counties of Los Angeles, Orange and San Diego, receiving less than a 1-percent increase per county.

Summary

Offshore. With the exception of the problems associated with the disposal of oil and oil covered debris from a major spill reaching shore, impacts from solid waste generated offshore will be insignificant.

Onshore. Based on Harris Model population projections, solid waste generated by onshore activity and population increases will be negligible and should be handled by existing landfill sites; there could be an increase in collection and transportation services. However, the largest increase due to Sale No. 48 activity is less than 4 percent.

b. Baja California Impacts: No significant impacts anticipated.

c. Tankering Leg Impacts (Point Conception to Point Reyes):

Population changes due to Proposed Sale No. 48 related activity does not show an increase of more than 0.21 percent for any county over the life of the project. Therefore, no significant impact is expected.

d. Cumulative Impacts: Cumulative impacts on solid waste management systems will be discussed using those activities listed Chapter I.E (existing Santa Barbara leases, Sale No. 35 SOHIO project, Vaca Tar Sands project etc.,).

i. Offshore: Table III.E.10-4, based on Harris Model OCS employment projections, provides a county by county breakdown of projected solid waste tonnage that would be generated offshore for:

Sale No. 48.
Cumulative (existing Santa Barbara and Sale No. 35 leases).
Combined total (Sale No. 48 plus cumulative).

The figures indicate that solid waste tonnage will increase for each county with Ventura receiving the largest increase (12,120.8 tons/year or 2.02 percent of the 1985 projected solid waste total without OCS activity).

The potential impacts due to oil and oil soaked debris from spills, as described in Section III.E.10.a.i, will be increased due to the increased probabilities and numbers of spills associated with the additional activity of Santa Barbara leases and Sale No. 35 leases (see POCS Reference Paper No. VI for a detailed discussion on oil spills).

ii. Onshore: Cumulative impacts for solid waste generated onshore would be less than 1 percent of the projected 1985 normal tonnage for all the counties, except Santa Barbara County (14.21 percent) and Ventura County (9.58 percent) (Table III.E.10-5). This would put additional pressure on existing landfill sites; and the need for altercation of transportation and collection services may be required to handle the increased tonnage, especially, in Ventura and Santa Barbara counties. Table III.E.10-6 indicates that Ventura and Santa Barbara County would have an additional 224.8 and 173.4 truckloads of solid waste per week due to cumulative projects in 1986 (peak population year).

Table III.E.10-1

1985 PER CAPITA AND TOTAL SOLID WASTE TONNAGE BY COUNTY, COMPARED TO 1985 PROJECTED SOLID WASTE TONNAGE GENERATED OFFSHORE (PEAK EMPLOYMENT YEAR)

County	1985 Population (From Table II.G.2.a-4)	Per Capita Tonnage of Solid Waste/ yr. (Exc. Agr.)(1)	Total 1985 Solid Waste Tonnage	1985 Peak Year Employment (Based on most probable Resource Est.)	Total Tonnage Solid Waste Generated By Peak Year Offshore Development (2)	% Total 1985 Offshore Generated Waste (2,610.8 MT) In Relation To 1985 Individual County Solid Waste Totals
Santa Barbara	317,100	0.9090 MT (1.0000 T) est.	288,273 MT (317,100 T)	565	421.8 MT (464.0 T)	0.91 %
Ventura	584,100	0.9496 MT (1.04467 T)	544,683 MT (610,151 T)	1,167	871.3 MT (958.4 T)	0.47 %
Los Angeles	7,377,900	1.568 MT (1.7248 T)	11,568,546 MT (12,725,401 T)	1,512	1,128.8 MT (1,241.7 T)	0.02 %
Orange	2,173,400	0.8273 MT (0.9100 T)	1,797,994 MT (1,977,794 T)	75	56.0 MT (61.6 T)	0.14 %
San Diego	2,055,700	1.000 MT (1.100 T)	2,055,700 MT (2,261,270 T)	178	132.9 MT (146.2 T)	0.13 %
TOTAL	12,508,200		16,265,196 MT) (17,891,716 T)	3,497	2,610.8 MT (2,871.9 T)	0.01 %

MT = Metric Tons
T = English Tons
(1) = Personal communications with County Sanitation Departments and Regional Planning Departments, 1977.
(2) = Based on 2.04 Kg. (4.5 lbs) of solid waste/person/day, Snyder, 1974; CEQ, 1974.

Table III.E.10-2

PROJECTED 1985 TOTAL SOLID WASTE TONNAGE AND 1986
SOLID WASTE GENERATED FROM SALE NO. 48 RELATED POPULATION INCREASES

County	1986 Peak Year Waste Tonnage Generated By Proposed Sale No. 48 Related Pop. Increases	Total 1985 Solid Waste Tonnage/Year Without No. 48	% Increase Due to No. 48	Per Capita Tonnage/Year
Santa Barbara	3,180 MT (3,498 T)	288,273 MT (317,100 T)	1.10 %	1.000 (Est.)
Ventura	16,692 MT (18,361 T)	554,683 MT (610,151 T)	3.01 %	1.0446
Los Angeles	15,611 MT (17,172 T)	11,568,546 MT (12,725,401 T)	0.13 %	1.7248
Orange	205 MT (226 T)	1,797,994 MT (1,977,794 T)	0.01 %	0.9100
San Diego	3,172 MT (3,489 T)	2,055,700 MT (2,261,270 T)	0.15 %	1.1000
TOTAL	38,860 MT (42,746 T)	16,265,196 MT (17,891,716 T)	0.24 %	

Table III.E.10-3

ESTIMATED INCREASED TRUCKLOADS/WEEK OF SOLID WASTE
FOR PEAK YEAR (1986) AND PERCENT CHANGE

County	Projected Population Increase-Peak Year 1986	Projected Normal Solid Waste Tonnage 1985	#48 Peak Year Solid Waste Tonnage From Population Increase (1986)	Estimated Number Truckloads/ Week (1985) (Assumes 5 Tons/ Load)[a]	Estimated No. Of Increased Truckloads/Week Due to No. 48	% Increase In Truckloads Due to No. 48
Santa Barbara	3,498	288,273 MT (317,100 T)	3,180 MT (3,498 T)	1,219.6	13.5	1.11 %
Ventura	17,577	544,633 MT (610,151 T)	16,692 MT (18,361 T)	2,346.7	70.6	3.01 %
Los Angeles	9,956	11,568,546 MT (12,725,401 T)	15,611 MT (17,172 T)	48,943.8	66.0	0.13 %
Orange	248	1,797,994 MT (1,977,794 T)	205 MT (226 T)	7,606.9	0.86	0.01 %
San Diego	3,172	2,055,700 MT (2,261,270 T)	3,172 MT (3,489 T)	8,697.2	13.4	0.15 %
Total	34,451	16,265,196 MT (17,891,716 T)	38,860 MT (12,746 T)	68,814.3	164.4	0.24 %

[a] 20 cubic yard truck can carry 10,000 pounds of refuse, Research and Education Association, 1978.

Table III.E.10-4

CUMULATIVE SOLID WASTE TONNAGE GENERATED OFFSHORE BY COUNTY
DURING PEAK EMPLOYMENT YEAR, 1986

	Sale No. 48 1985 Peak Year Employment (Based on Most Probable Resource Estimate)	Sale No. 48 Total Solid Waste Generated Offshore (Peak Year 1985) (1)	Cumulative Employment (Peak Year 1986) (2)	Cumulative Solid Waste Tonnage Generated Offshore Peak Year (1986)	Combined Sale No. 48 Plus Cumulative Solid Offshore 1986	1985 Total Solid Waste Without OCS Activity	% Increase Due To Offshore Activity
Santa Barbara	565	421.8 MT (464.0 T)	2,749	2,052.4 MT (2,257.6 T)	2,474.2 MT (2,721.6 T)	288,273 MT (317,100 T)	0.86 %
Ventura	1,167	871.3 MT (958.4 T)	13,592	10,147.6 MT (11,162.4 T)	11,018.9 MT (12,120.8 T)	544.683 MT (610,151 T)	2.02 %
Los Angeles	1,512	1,128.8 MT (1,241.7 T)	1,765	1,317.7 MT (1,449.5 T)	2,446.5 MT (2,691.2 T)	11,568,546 MT (12,725,401 T)	0.02 %
Orange	75	56.0 MT (61.6 T)	118	88.1 MT (96.9 T)	144.1 MT (158.5 T)	1,797,994 MT (1,977,794 T)	0.01 %
San Diego	178	132.9 MT (146.2 T)	234	174.7 MT (192.2 T)	307.6 MT (388.4 T)	2,055,700 MT (2,261,270 T)	0.01 %
Total	3.497	2,610.8 MT (2,871.9 T)	18,458	13,780.5 MT (15,158.6 T)	16,391.3 MT (18,030.5 T)	16,265,196 MT (17,891,716 T)	0.10 %

(1) Based on 2.04 rg (4.5 (4.5 lbs.) of solid waste/person/day, Snyder, 1974; CEQ, 1974.
(2) Cumulative = existing Santa Barbara leases and Sale No. 35.
MT = Metric Tons.
T = Tons.

Table III.E.10-5

PROJECTED SOLID WASTE TONNAGE GENERATED BY POPULATION INCREASES RELATED TO NO. 48, S.B. AND NO. 35, ALL OTHER CUMULATIVE-LNG, ETC., COMBINED TOTAL

	Population (1986)-(Harris Model)					Solid Waste Generated 1986					
County	#48	#35 and S.B. Channel Leases	All Other Cumulative LNG, ETC.	Total	Per Capita Tonnage/Year	#48	#35 and S.B Channel Leases	All Other Cumulative LNG, ETC.	Total	1985 Solid Waste Without Projects	% Increase Due To OCS And All Other Cumulative Projects
Santa Barbara	3,498	6,398	35,185	45,081	1.000 (est)	3,180 (3,498)	5,816 (6,398)	31,986 (35,185)	40,983 (45,081)	288,273 (317,100)	14.21%
Ventura	17,577	34,579	3,790	55,946	1.0446	16,692 (18,361)	32,837 (36,121)	3,599 (3,959)	53,128 (58,441)	554,683 (610,151)	9.58%
Los Angeles	9,956	3,303	10,945	24,204	1.7248	15,611 (17,172)	5,179 (5,697)	17,162 (18,878)	37,952 (41,747)	11,568,546 (12,725,401)	0.33%
Orange	248	136	7,994	8,378	0.9100	205 (226)	113 (124)	6,613 (7,274)	6,931 (7,624)	1,797,994 (1,977,794)	0.38%
San Diego	3,172	491	-574	3,089	1.1000	3,172 (3,489)	491 (540)	-574 -(631)	3,089 (3,398)	2,055,700 (2,261,270)	0.15%
Total	34,451	44,907	57,340	136,698		38,860 (42,746)	44,436 (48,880)	53,442 (58,786)	142,083 (129,166)	16,265,196 (17,891,716)	0.87%

Table III.E.10-6

PROJECTED INCREASED TRUCKLOADS/WEEK OF SOLID WASTE GENERATED BY CUMULATIVE POPULATION INCREASES

	1985[1] Solid Waste Without Projects	1986 Total[1] Cumulative Solid Waste/ Year (#48, #35 & S.B., Other)	Projected[2] Truckloads/Week 1985 Without Projects	Projected 1986[2] Total Cumulative Increased Truckloads/ Week	% Increase
Santa Barbara	288,273 MT (317,100 T)	40,983 MT (45,081 T)	1,219.6	173.4	14.2%
Ventura	554,683 MT (610,151 T)	53,128 MT (58,441 T)	2,346.7	224.8	9.5%
Los Angeles	11,568,546 MT (12,725,401 T)	37,952 MT (41,747 T)	48,943.8	160.6	0.3%
Orange	1,797,994 MT (1,977,794 T)	6,931 MT (7,624 T)	7,606.9	29.3	0.3%
San Diego	2,055,700 MT (2,261,270 T)	3,089 MT (3,398 T)	8,697.2	13.1	0.2%
Total	16,265,196 MT 17,891,716 T	142,083 MT (129,166 T)	68,814.3	601.2	0.9%

(1) Solid waste figures tanker from Table III.E.10-5.
(2) 20 cubic yard truck can carry 11,000 pounds of refuse assumed.
MT = Metric Tons.
T = Tons.

11. Impact on Recreation (Beach and Shoreline Recreation)

a. General Impact by Lease-life Stage: To analyze the impacts on beach and shoreline recreation, hydrocarbon leases will be broken into four stages; exploration, development, production, and abandonment. Outdoor recreation is an important component of the Southern California environment. Some opportunities are in extremely limited supply and swimming beaches are in this category. Even though beaches are abundant in Southern California, the combination of auspicious climate and a large, highly mobile population creates a demand which far outstrips the supply. Any loss in opportunity for one resource such as a beach defiled by oil, will likely be made up to some degree by persons seeking alternative recreation elsewhere, such as going to another beach, going hiking in the mountains, or any of numerous other options. This represents a loss to society due to the increased crowding occasioned at the alternative activities selected, and thus may be a depreciation of quality for those alternatives. Physical capacity is obviously limited, and at some sites regulations limit attendance to ecological carrying capacity. It also represents a loss to society in that the most desirable location cannot be used and a second choice must be substituted.

Beach and shoreline activities susceptible to oil related impacts include surfing, swimming, skin and scuba diving, sunbathing, sightseeing, and fishing. Fishing can be broadly construed to include diverse activities ranging from surf fishing and clam digging, to grunion hunting.

There will be overlaps among the various development stages, but individual stages will tend to dominate varying periods through the life of the lease.

i. Exploration: During this stage, geophysical data is being gathered. This consists of bathymetric, seismic, gravity, magnetic and presence of hydrocarbons information gathering. Test holes or wells will be drilled. The greatest effect will be in increased marine traffic which should have minor effects on beach recreation. Ocean solitude would be affected somewhat by increased activity. Nearby seismic data gathering could affect divers if explosives are used. Onshore effects would be due to congestion and increased activity around airports, harbors or mustering areas.

These activities are currently engaged in in the Bight but their tempo will undoubtedly increase if this proposal is implemented. Exploration lasts for five years after the signing of leases and will be considered as part of the development process after that time period. Development activity will extend to about 1985. Individual disruptions for nearby recreationists would be on a scale of a few hours and be entirely temporary. Disruption of solitude

on wider areas of ocean could persist for several days to weeks at a time but be minor in overall impact.

ii. Development: In the development stage of lease areas, platforms, pipelines, separation and storage, and support facilities are being built and installed. Wells are being drilled from barges and platforms. Most population increases or dislocations occur at this stage, resulting in increased pressure on local recreation facilities. Although no new onshore terminal or production facilities are postulated by the USGS to result from this proposal, 4 operations facilities are predicted. If, as postulated, this proposal results in a total of only 24 ha (60 acres), then these impacts may be relatively minor. In addition, control of development by the California Coastal Commission will probably mitigate imports somewhat. Onshore impacts could occur where the storage of construction material or building of mustering areas caused a change in land use or esthetic damage. If located near existing or potential recreation sites, their environmental quality could be seriously degraded. Such changes in land use would also affect wildlife observation opportunities on land which is presently undeveloped and in near natural condition.

Construction of industrial sites in rural areas would result in increased pressure on existing resources, changes in esthetic quality and higher land values. This could make recreation land acquisition more expensive. Wildlife habitat destruction or alteration through land use change would be detrimental to recreational uses of wildlife. Loss of open space will also occur. The probability is high that oil-related industrial sites will be proposed for rural portions of the Ventura and Orange County coastal areas. In Ventura or Orange Counties, the loss would involve existing recreational uses in many cases.

Platforms will not physically interfere with beach or near shore activities as they will be a minimum distance of three nautical miles offshore. The newer ones will, however, be quite visible and have an esthetic impact on beach users. Platform placement and attendant activities in waters near San Miguel, Santa Rosa, Santa Cruz or Santa Barbara Islands may create enough disturbance to certain species of birds and animals indigenous to those islands to result in their disappearance. This would be a very real, and in the case of rare or endangered species, such as some of the pinnipeds and the brown pelican, irreversible and irreplaceable loss to those people who value these creatures and enjoy watching them for rest and relaxation.

Vessel traffic will be greatly increased, shuttling men and equipment between shore and drilling sites. The impact would be visual and not particularly deleterious as ships and boats are generally accepted to be part of the ocean scene. Small oil slicks from these vessels are also considered adverse to recreational values.

Impacts upon recreation activities can be caused by the many activities precipitated on shore in support of offshore drilling. Construction of equipment storage and marshalling yards, communications and

navigation facilities, transportation centers and associated urban development will all affect recreation. Equipment yards could infringe upon shoreline recreation by converting the backshore to non-recreational use, restricting access to the shore, converting wildlands to industrial sites and by altering sea esthetics. Communication sites would generally be visible to large areas and could remove land from recreational usage. Transportation support could remove nearby coastal land and open space from recreational use. Induced urbanization will result from the influx of workers who will be involved with an expanded oil development. A maximum increase of 34,426 population can be expected by 1986. This type of increase places additional demands on area recreation resources. At an average of five acres of local park acreage per 1,000 people, this creates a need for an additional 175 acres. This impact would be scarcely felt occurring in heavily populated Los Angeles or Orange Counties, but will be very noticeable occurring in an area like Ventura County.

This population increase due to this proposal will affect Ventura County most heavily at an estimated increase of 17,577 and Los Angeles County secondly with an estimated increase of 9,956. The local park acreage needs occasioned by these increases are 88 acres and 50 acres, respectively. Los Angeles County already has a local park acreage shortfall, particularly in inner city areas so this will exacerbate an existing problem.

Onshore development which takes place on any of the offshore islands would have a potentially serious impact on existing and potential recreational values there. Many of the islands, particularly the northern Channel Islands and Catalina are likely prospects for pressure. All of the islands' surrounding waters receive heavy visitation, with San Nicolas and San Clemente receiving lighter influxes due to greater distance and military restriction. Landings are restricted at all of the islands with the exception of Santa Barbara Island, the two easterly islands of Anacapa and portions of Catalina. This limits the onshore recreation benefits of those islands but does contribute to the solitude and naturalness of them, which is their major value. Coastal Commission policies tend to moderate the pressure for island development. Interest in creating a national park which includes all the northern island has persisted for years. Any developments on the islands could depreciate their value for park purposes.

San Miguel, San Nicolas and San Clemente Islands are all military reservations and could be used by private industry only with the Department of Defense's permission or if they were declared surplus totally or in part and sold. Anacapa and Santa Barbara are parts of the National Park System and not likely to be used for anything other than their current uses. Catalina is privately owned and used

for conservation purposes. Much of it has been turned into open space and park use under an agreement with Los Angeles County. The possibility exists, though remote, that a portion of it could be sold or leased for such purposes as separation and storage facilities, equipment yards and communication sites. The Coastal Zone Conservation Commission, Los Angeles County Planning Department and State Lands Commission would have to be involved and satisfied before this type of land use could take place.

Santa Rosa Island is privately owned and used for ranching purposes. Most of Santa Cruz Island was recently purchased by the Nature Conservancy. Though retained in rural usage, the same possibilities exist with Santa Rosa as at Catalina. Santa Barbara County officials have jurisdiction along with the two State agencies for approving activities of this nature.

In the past, proposals to use some of the islands for oil-related industrial sites have been made by the energy industry and their implementation would constitute an adverse impact probably for the duration of the project. It is possible to restore the sites for recreational use once the project has ended.

If the pipelines estimated to result from this proposed sale are brought ashore in a beach area used for recreation, there will be an impact on recreational actities. The area of a beach disturbed by pipeline construction will be small (about 30-50 feet wide), and the first high tides following burial of the pipeline will serve to restore the beach terrain. Restoration of the beach ridge through natural processes will take longer, most likely requiring a storm tide or high winds to obliterate the effects of excavation. Physical intereference with recreational activities from excavation will be minimal and short-lived, lasting for an estimated period of one to ten weeks. Since coastal physiography generally limits the areas in which pipelines can be brought ashore to the alluvial plain areas, adverse impacts to the wetlands which often occupy these places could occur. If this impact occurred, we would consider it to be disruptive for recreational purposes during the period of construction. Since water turbidity would quickly restore to normal, the impact would not be significant nor long lasting.

If pipeline terminal or transfer facilities are located on or near a beach or other area used for recreation, there will be an adverse impact from disruption during the construction phase and elimination of about 6 ha (15 acres) per terminal plant for recreational and other uses. The GS estimates a total of 24 ha (60 acres) could be affected as a result of this proposal. This latter impact would be long term and restoration of the area, if attempted at all, would have to await depletion of the offshore production which the plant was designed to serve. These impacts may also diminish the quality

of the area for recreational enjoyment. The construction of a refinery in Ventura County or elsewhere could affect up to 405 ha (1,000 acres) in a way similar to terminal plants.

The impacts of pipeline and terminal facilities construction on recreation would be mitigated somewhat if the appropriate governmental authorities zone effectively and enforce the zoning. Effective screening and siting, as well as the use of mitigatory designs and materials could reduce the impact of these facilities. The restriction by local or State authorities of this type of construction to the time when recreational use is at its lowest point would also mitigate the impact considerably.

Hydrocarbons will be transported by a combination of barging and tankers or pipelines, and the shoreline area involved with landing of the material can be surmised for the combination. Barging will very likely take advantage of existing port and offshore unloading facilities. These facilities exist at Port Hueneme, which already handles much oil field equipment; the marine terminal at El Segundo, the Los Angeles-Long Beach Harbor complex and San Francisco Bay area facilities. Other potential deepwater port locations in the area are at Hueneme Canyon, offshore Port Hueneme, and Port Fermin. Pipelines from leases in the Santa Barbara Channel, San Pedro Bay, and offshore Dana Point-San Diego, could come ashore at most any location. Deep intervening basins and current technology require that any pipelines from Tanner-Cortes lease areas be routed northward along the Santa Rosa-Cortes Ridge to the Northern Channel Islands, then easterly along the island shelf to land in the Oxnard-Ventura area. Any landing point with the possible exception of the heavily industrialized Los Angeles-Long Beach Harbor area, will very likely sustain impacts on the recreation resources in the vicinity.

Barging or lightering can adversely impact recreation through spills which intercept the beach. Barge traffic from lease blocks in the Santa Rosa-Cortes South tracts and the Santa Barbara-Catalina tracts poses a hazard to beaches extending from Oxnard to southern Orange County. These are the heaviest used beaches in the State. The loss of a lighter in the surf could effect a loss of 58,765 visitor days per event.

iii. Production: Wells are producing oil and gas in this phase and manpower requirements are relatively lower than for the development stage. Repairs must occasionally be made to existing wells and pipelines. Impacts are similar to those of the development phase except that personnel requirements are lower, thus lowering demand for local or regional recreation facilities. Production occurs, usually, for about 20-40 years.

iv. Abandonment: Abandonment occurs after a field is economically exhausted. The effects would be the lowering of tax bases, with concomitant loss in bonding power to construct new recreation facilities, lessening of financial ability to maintain existing facilities, and esthetic impacts if abandoned equipment is left scattered around onshore. This is prohibited for Federal waters but could occur in other areas. Platforms are dismantled, so any impacts attendant thereto would be temporary disruption due to wrecking activities and transportation of salvage.

v. Oil Spills: Oil spills can occur at any stage in the life of a lease, but are more likely to occur during the development and production stages. Large spills are infrequent while small ones are more common and persistent in occurrence. Progress has been steady in prevention and containment of spills, but they do continue to occur. Statistical evidence indicates that several spills exceeding 1,000 bbl will occur if this proposal is implemented, and numerous small losses will occur from platforms and vessels. Prevailing wind and currents almost assure that this oil will reach shore in time, if not contained or degraded by natural processes. In the worst case, a nearshore oil spill on an incoming tide with an onshore wind could cover beaches in less time than it would take to mobilize containment activities. If this occurred in the summer, and particularly on a mainland shore, recreation losses would be great until beaches and nearby waters could be cleaned. Water sports, such as swimming, surfing, diving, spearfishing, underwater photography, fishing for finfish and shellfish, and boating would be directly affected.

Small spills probably would create a greater or lesser nuisance rather than a major impact. If frequent and persistent, they could cause an undesirable situation which could occasion large reductions in use of certain areas or even their abandonment by boaters or beach users. Several factors indicate that the more severe impacts probably would not occur. These are that most spills would be recovered or dispersed and occur randomly scattered in both time and place which would render their continued and continuous impact on any particular place unlikely.

Slicks and tar balls, whether from a large spill or small ones, depreciate the quality of the beach and nearshore recreation experience. Activities as diverse as jogging and Scuba diving are affected. It is unlikely that many divers or surfers would venture into noticeably oily waters; thus, the loss would be one of opportunity.

Other seashore related activities such as beachcombing, shell collecting, painting, shoreline nature study, camping and sunbathing would be made much less attractive for an indeterminate period where an oil spill had coated a beach.

Removal of oil from beaches used for recreation would probably involve removal of the contaminated sand, and possibly replacement of the sand if needed. The time required for cleanup in this case would depend on the extent of beach affected. Recreational use of the area would be precluded during the time that oil covered the beach and also during cleanup. We estimate the duration of this impact, if it occurred, to range from one to 60 days.

The impacts of an oil spill discussed above would be more keenly felt if the recreation area involved is intensively used or considered to have unique or outstanding recreational values. Not only would the impact be felt by the recreational users of these areas, but the community of businesses whose economic well-being depends on use of their recreational resources by tourists would be affected as well. If an oil spill were to cover outstanding recreational beaches during the height of the tourist season, the impact could be expected to be more severe in that tourists would not be attracted to a beach area contaminated by oil or undergoing a cleanup process, and there would be a resultant economic loss to the local area. Fourteen percent of Southern California's 8.5 million out-of-state visitors indicated beach or coastal visits were part of their itinerary. Thus some portion of 1,190,000 people would be affected by an oil spill. Mostly likely, a shift of visits to unaffected beach areas would occur but some trip cancellations could ensue. The effects would be local rather than regional in scope. Equally important, however, is that the quality of life for residents of the entire region may be diminished by the knowledge of despoiled beaches in the area.

Esthetically, considerable damage may be wrought for varying lengths of time depending upon the success of cleanup. Most losses will be temporary and partially offset, as many people will avail themselves of unaffected alternative recreation sites or activities, Other losses, though temporary, are longer term and thus may represent an intrinsic loss to society. Such damages as bird kills and losses of intertidal animals and marine mammals may be repaired in time, but for the duration of their depletion, do represent a loss to those who enjoy watching them or take comfort in knowing that they exist.

Mead and Sorensen (1970) in the process of analyzing the cost of the Santa Barbara oil spill took a recreation survey. Their survey findings as they related to impacts, briefly indicate that: approximately 53 percent of the respondents stated that they used the beach <u>less</u> in the 12 months following the spill than in the 12 months preceding it. Four percent said they used the beach more

after the spill; 37.1 percent said they visited the beach the same number of times. In more detail, the average (mean) number of beach visits had declined from 27.9 in the previous 12 months to 20.8 in the following 12 months. Thus, their survey indicates that area residents visited the beach fewer times (on average) in the 12 months following the spill. They, therefore, concluded that an aggregate net reduction of 744,000 beach visits occurred in the 12 months following the spill among Santa Barbara coastal area residents over the age of 16.

Mead and Sorenson (1970) calculated the total loss of recreational beaches for intermittent time periods at $3,150,000 for Santa Barbara and Ventura Counties.

Some tourism losses occurred as evidenced by drops in "bed tax" collections in Santa Barbara and Montecito. Offsetting gains occurred at nearby Goleta which resulted in an overall increase for Santa Barbara County for 1969. They concluded that no overall loss occurred due to offsetting gains elsewhere within the county and region, although private losses to restaurants and motels near the beach probably did occur.

Small spills will prove to be annoyances more than anything. Beaches throughout most of the San Diego, Los Angeles, Ventura and Santa Barbara County area are subjected to tar balls from natural seeps in the ocean floor, from wastewater outfalls and probably from ships. These frequently are found buried or on surface of the sand in the surf zone or tossed above the wave-wash zone on the beach. They soil feet and clothing and thus are a nuisance. Small spills or the remnants of large ones may contribute tar balls to the beaches and thus cause a minor impact.

In summary, large spills will cause losses which could be major, though not permanent. If a spill or chronic contamination caused the demise of any species either totally or throughout a significant portion of its range then that would be a major adverse impact. If the species was important recreationally, then its loss would be a loss to the recreation resource base. Persistent contamination of some beach areas by tar balls will undoubtedly reduce the area's popularity.

Another important factor affecting potential impacts is changes in land use resulting in open space and recreation land loss. The creation of adequate land use plans, effective zoning and strong enforcement by enlightened local officials will play a large role in the ultimate effect of leasing on recreation and open space.

The oil spill model estimates that, within a 60 day trajectory, a 65 percent chance exists that one spill resulting from this proposal will contact a high intensity use beach during the life of this proposal. The chance that a high use diving area will be contacted rises to 87 percent with 2 spills expected.

b. Impacts by Area

i. Santa Barbara Channel Impacts: Proposed leases in this area will produce an estimated 3.1 spills exceeding 1,000 bbls. Spills starting on these areas, according to the spill model, exceed a 10 percent chance of hitting a mainland segment with recreation resources, only once for a 60-day trajectory and that is in Segment 29. The most heavy concentration of shoreline impacts is on the Northern Channel Islands which have light beach use. Diving will be more heavily impacted, however, as the island waters are heavily used. Given the occurrence of an oil spill on the group of tracts (P-7) just northwest of Santa Cruz Island, the chance of it being struck by the spill is 74 percent within ten days (POCS Reference Paper No. VI, Table 2B).

The segment most likely to receive a spill affecting recreation on this coast is No. 28 at 12 percent for 10 days and 15 percent for 60 days. A 1,000 bbl spill striking this area after 30 days at sea and remaining on the beach for 30 days would affect up to 197 km (116 miles) of shoreline. This could reduce recreational visitation by 841,000 for one event. For 3.1 occurrences, and not allowing for population growth and increased spill-over effects from the Los Angeles area, the loss could be a visitation of 2,607,000.

ii. San Pedro Bay Area Impacts: Proposed leases in the area will produce an estimated 0.47 spills over the lifetime of the project. This is a relatively low spill rate and the harbor complex contains few recreational beaches and is somewhat protected by the breakwaters. Spills starting on these areas, according to the spill model, equal or exceed a 10 percent chance of hitting within a 60-day time period following segments having recreation resources: 21, 22, 23, 25 and 53. The highest likelihood of hits once a spill starts is for Segments 23 and 53. A 1,000 bbl spill hitting just 5 beaches in Segment 23 would reduce visitation by 283,700 in 30 days based upon average yearly use. If the spill struck farther north in Los Angeles or in northern Orange County in hot summer weather, the weekend loss alone for a 30-day spill could total 10,000,000 visitors, but the chance of that occurring is low. Segment 53 is Santa Catalina Island and a spill reaching those waters would affect thousands of divers. There is a 13 percent chance of at least one spill reaching Catalina from this proposal within 10 days.

iii. Dana Point-San Diego Areas: A risk of only 0.17 spills exists from the area. If a spill occurs on one of the areas, then the greatest impact potential exists for Segments 20, 21, 22, 23 and 59, with chances ranging up to 35 percent for 60-day trajectories. Segment 23 with a 35 percent impact chance if a spill starts, has a risk of only 6 percent that a spill will occur and contact it. Even though beach usage is relatively high, the impact potential is quite low.

iv. Santa Rosa Area Impacts: The spill risk from this area is very small at 0.06 incidents and only San Nicolas Island has any substantial risk of being contacted should a spill occur. There is no public beach recreation on this island and use of the surrounding waters is restricted by the Navy; therefore, little recreation impact potential exists.

v. Tanner-Cortes Area: The spill risk for this area is 1.14 incidents, but San Clemente Island is the only segment with a significant risk of being struck should a spill start on these tracts. There is a 16 percent chance of San Clemente Island being struck by at least one spill within a 60-day trajectory. No public beach recreation would be affected since this is a Navy reservation, but there is a moderate amount of recreational diving around the island. With the prospect of at least one spill, considerable risk exists that the light amount of recreational diving on the Tanner-Cortes Banks will be impacted.

vi. Santa Barbara Island Area: A small spill risk at 0.06 incidents exists at these tracts. If a spill occurs, the risk is as high as 18 percent that Santa Barbara Island will be contacted. Catalina and San Clemente are other islands significantly hazarded if a spill occurs. There is a 5 percent risk of a spill occurring and contacting Santa Barbara Island. Similarly, the risk is 22 percent for Catalina Island and 16 percent for San Clemente for a 60-day trajectory. There is no beach recreation at Santa Barbara Island, but tidepools and diving are important recreational pursuits, as is watching pinnipeds on the island.

vii. Baja California Area Impacts: The risk to recreation beaches in Baja is negligible. For diving, the only significant risk is at the Coronado Islands which have a 29 percent risk of being struck should a spill occur on the tracts directly off San Diego. The risk that a spill will occur and strike these islands is only 4 percent, however. There is little hazard to Baja recreational diving or beach use.

viii. Tankering Leg Impacts: The risk of spill is 0.65 incidents. Should a spill occur, the most likely (greater than 10 percent) segments to be impacted within a 60-day trajectory are 38 through 43. Segment 42 has a 30 percent risk, while 43 has a 20 percent risk of being contacted should a spill occur. None of these segments has a higher risk than 5 percent of a spill occurring and contacting it.

c. Cumulative Impacts

i. Santa Barbara Channel Area Impacts: The cumulative total risk of large spills for this area is 9.63 incidents.

Based on average beach use, this would produce a visitation loss of over 8 million. No data were available to quantify diving losses for this or subsequent areas.

ii. San Pedro Bay Area Impacts: The cumulative total risk of large spills for this area is 4.96 incidents. This would produce a visitation loss of 1,488,000 which could possibly reach much higher figures.

iii. Dana Point-San Diego Area Impacts: The cumulative risk is no higher at 0.17 incidents than for this proposal alone. No loss is computed because of the low risk.

iv. Santa Rosa Area Impacts: The cumulative risk is 0.10 incidents. There is no public beach recreation at San Nicolas Island and diving data are not available.

v. Tanner-Cortes Area Impacts: The cumulative risk is 3.67 incidents. There is no public beach recreation at San Clemente Island, the only segment having significant potential for being contacted, and no data were available on recreational diving.

vi. Santa Barbara Island Area Impacts: The cumulative risk is 0.47 incidents. The loss of visitors could reach 3,800.

vii. Baja California Area Impacts: There is no significant increase to beach recreation or diving than that due to this proposal.

12. Esthetic Values: Appreciation of esthetic values is inextricably interwoven with many other human pursuits, some of which are measured in terms of dollars or visitor days, and numerous others which are neither measured nor susceptible to measurement. Adverse esthetic impacts frequently do not result in total loss of the resource such as people refusing to go to a beach because of a cluttered view, but rather, some unquantifiable depreciation of their total enjoyment of the experience. Quantified esthetic loss due to esthetic changes must be regarded as minimums because of the many "users" who are never sampled. Impact on esthetic values will occur from both normal operations as well as failures such as oil spills. Various stages of development within the proposed action are analyzed in terms of their impacts from normal operations, and where probable, from accidents.

Visual quality is the most important esthetic parameter that we are concerned with in this analysis, followed by sound, smell, and solitude. Analysis of visual impact must presume an observer positioned at a particular location and in this region, observers are to be found in varying numbers at nearly every conceivable position offered by Southern California geography. Untold millions of observers, pass by on the Coast Highway, some on commercial ventures, many commuting, joyriding or visiting and numerous others sightseeing. Residents occupy areas ranging from the wet sand beaches to the commanding heights of ocean bluffs and coastal mountains, such as the Santa Monica Mountains. Chief among the values of coastal homes is the ocean view and participation in the sea environment. Beaches, both private and public, attract millions of visitors during all parts of the year. Offshore, island dwellers and visitors, as well as boaters, view vast expanses of the ocean. Viewers from all of these positions derive some fraction of their enjoyment from the coastal and ocean esthetic values. Of all of these categories, recreation visitation is the only parameter commonly monitored and it will be our basis in attempting to assess the impacts on esthetics.

Many competent economists have tried to attach dollar values to esthetics and have been unsuccessful. Such attempts are inevitably doomed to failure for many reasons, among them being that social, economic, cultural and philosophic backgrounds vary one's perception of what is esthetic so broadly that a standard definition from which to start is not possible. It is possible to analyze from an artistic or architectural basis what is or is not "esthetic" but it is difficult to quantify the magnitude of non-esthetic features. For example, if a drilling platform is adjudged a discordant feature because it presents disharmony in lines, texture, color or surroundings, it is contestable to say that its presence depreciates the esthetic quality of the area by 10 percent, 50 percent or 100 percent, because it may not depreciate one observer's

enjoyment by an iota, while conversely, totally damaging that of another.

In this analysis, quantification will identify only that portion of the viewing public who may be affected in one way or another by changes in the esthetic situation. That portion of the public using the coast's esthetic resource, which is susceptible to some analysis, is the beach visitor, because most managing agencies keep visitation records of one form or another. Boating registration and use figures are available and will be used. Other categories of users are not readily quantifiable. Residents, for example, do not use all of their time enjoying the sea view. The figures developed subsequently should be regarded as minimum numbers as they only consider the measured portion of one segment of esthetic users.

a. Source of Impacts and Duration: Esthetic impacts will occur both offshore and onshore and be due both to direct and indirect results of this proposed sale. They will range in duration from very transitory to nearly permanent. Some will be attributable to normal activity and others will be caused by unusual or accidental events.

Offshore impacts during exploration will be caused by increased vessel and air traffic engaged in geophysical data gathering. The activities will include the tracing of grid tracks across the sea during which seismic, magnetic, hydrocarbon and gravity recording instruments will be arrayed. Some noise and coring of the sea bottom will occur. Occasionally explosives may be used. This activity currently takes place, though at a lower level than it will if this proposal is implemented. Later in the exploration process, test wells will be drilled and production of hydrocarbons from these wells could be either barged to shore, or flared at sea. Normal impacts accruing would be noise, increased offshore traffic, some vessel oil losses, production of some turbidity from drill cutting and mud disposal, and loss of solitude. Particulates and odors from flaring would degrade air quality to a limited extent. These activities will last for five years after the leases become effective, after which the exploration phase as such will terminate. Loss of esthetic values will be minimal consisting primarily of loss of solitude in the ocean areas affected by exploration. We do not foresee any persisting or significant losses, only minor disruption during normal offshore exploration activities.

Onshore impacts during exploration could entail land use changes for equipment storage, heliports, communications and navigation equipment construction. Increased traffic around harbors or marinas will have some visual impact. Construction activities could have a deleterious effect, particularly if they take place in areas which are largely natural at present. Communications facilities which

occupy prominent high points have a large visual impact potential, both from the facilities themselves which occupy high topographic points, and from access road construction and site leveling. Sensitive design, siting, choice of materials and landscaping could reduce the visual impact of the installations while road location, design and construction can be accomplished in a manner compatible with the terrain and hence be visually acceptable. There is a distinct potential for some loss of esthetic values in localized areas due to these installations. Those affected would be boaters, possibly residents, hikers, and some beach users. The duration would extend through the life of the petroleum fields, approximately to the year 2040, with gradual lessening of visual impacts as disturbed soil revegetated.

Accidental events which could occur during exploration would have adverse impacts. These include such problems as vessel loss, oil spills and landslides. Geophysical vessels or aircraft may be lost resulting in fuel and lubricating oil spills. Barges carrying test production could be lost through accident, thus resulting in oil spills, or flaring equipment could result in oil spills through malfunction. Exploratory wells entail a degree of risk because they are drilled in areas which are not fully defined geologically and may accidentally encounter unforeseen zones of high pressure. A risk of blowout exists, therefore, which would produce adverse esthetic impacts.

In summarizing, unsalvaged vessel losses not creating damaging oil spills would produce visual degradation for some and an interesting object of curiosity for many others. Oil spills from research vessels will be minor in extent and constitute little esthetic impact. Loss of a filled barge would constitute a more serious problem if it occurred nearshore where containment and recovery actions could not be rapidly and successfully executed. At sea under normal conditions, a spill resulting from such a mishap would probably be successfully controlled and oil recovered. Nearshore, where a barge may founder on rocks or in heavy surf, control of spilled oil is unlikely and esthetic damage in the form of visual pollution by oil-fouled rocks or sand and biological damage will occur. In an accident of this nature, a maximum of 2,000 - 3,000 bbl may be spilled. This would result in an instantaneous calm water spread of about 62 hectares (0.24 square miles) or a 884 m (2900 foot) diameter slick. In reality this slick would break up in the surf and be transported by longshore drift to come ashore at varying densities along an indeterminate length of shoreline. For purposes of this analysis the slick is presumed to move directly onshore, thereby coating the minimum length of 884 m (2900 feet) of shore. Beach capacities or beach density standards are expressed as either persons per lineal foot of public swimming beach or square feet per person. Adopting a density standard

of one person per lineal foot of shoreline, indicates approximately 2900 persons at one time are potentially affected by this spill. To determine the net effect in quantifiable terms, we have selected the recreation activity pattern most closely related to the esthetic resource. This resource demand is the "Sightseeing and Study" Activity Pattern category utilized by the California Department of Parks and Recreation for its coastal recreation activity demand assessment. In 1970, 27 percent of the south coastal (Point Conception to Mexico) State Park visitors interviewed had engaged in the "Sightseeing" subactivity portion, expending 26,190,000 activity days.[a] Demand by 1980 in this category should reach 35,700,000 activity days out of a projected total of 262,300,000 activity days. This represents 13.6 percent of total activity days. Accordingly then, 783 visitors will be affected by our scenario.

The persistence of the beach's oil fouling is purely conjectural as cleanup may successfully restore it within a few days. On the other hand, patches of oil may continue coming ashore for several weeks and oil which sinks into the sand may remain covered for months or years until normal periodic changes in beach sand transport mechanisms cause surfacing and/or resuspension of the oil. If sorbents such as straw are used to collect oil, the disruption might occur for approximately one week. Sand removal and replacement could take a considerably longer time period. Based on a one-week cleanup period, 4,380 visitor days[b] would be adversely affected. In addition to this category of "sightseeing," several other activities are interrelated with esthetics, among these being beachcombing, nature study, just relaxing, photography, painting, walking for pleasure and picnicking. It was not possible to determine the degree of

---

[a]The "activity day" unit is very different from the "recreation day" used in demand charts. An activity day is the participation by one person in one activity on one day. Under this definition, the visitor might therefore be counted one, two, or three, or possibly even four times (though his participation in an activity had to be one of his major purposes for the visit in order to be tabulated). A visitor might surf, swim, and play volleyball in the course of his one day at the area. He would then be counted as three "activity days" because he used all of these activities.

The term "recreation days" merely expresses the number of people visiting, and reflects somewhat the popularity of an area; "activity day," on the other hand, gives some idea of the popularity of an activity and enables prediction of the type and quantity of a natural resource needed to meet the demand for that particular activity.

[b]Visitor day is defined as one person spending 12 hours at a site, two persons spending 6 hours, etc.

overlap among these categories with the data we have, hence the 27 percent participation in sightseeing cannot be expanded to include, for example, those who indicated photography/painting as a major pursuit and who did not include sightseeing in their answer. This example is presumed to take place during the summer. Winter or other season occurrence would lower the impact due to lower off-season beach visitation.

An oil spill due to a well blowout is discussed in the following section dealing with production impacts.

The last source of exploration impacts is a landslide resulting from improper drainage or siting of a communications facility or other construction activity. An impact of this sort could occur in a location which would make it highly visible, thus affecting millions of viewers over a year, or it could be relatively hidden. No attempt can be made to quantify this type of impact with presently available information.

During the development stage, wells will be drilled, platforms constructed and placed, storage and processing facilities built, pipelines constructed and barging or flaring of some test or initial production will occur in the offshore area. Onshore, platforms will be constructed in dry docks, barges, equipment storage, and mustering yards will be built and land based processing and storage facilities constructed. Normal operations offshore will result in a relative loss of solitude in the areas affected, particularly in the less grequented areas outside of the Santa Barbara Channel and San Pedro Bay. Shore residents, beach users, island residents and boaters will be affected. A potentially serious loss in the esthetic sense would be the dissolution of the pinniped rookeries present on many of the islands, but particularly, San Miguel. This could be directly attributable to the loss of solitude which these animals require to persist. These constitute the largest assemblage of numbers and species present near a large population center, in this country and possibly in the world. Although not susceptible to massive exploitation such as close-in tours, their existence is a valuable regional and national resource. The loss of solitude would be of short duration in some cases where dry holes were encountered, persisting only a matter of weeks, or lasting for up to 40 years until abandonment of fields where sufficient hydrocarbon resources are discovered. Secondary results of the loss of solitude such as the loss of biological communities could be largely permanent.

Visual impacts will occur in the offshore area from drilling rigs, platform placement, barges, flaring, and work vessels. Small oil slicks from work vessels will appear, particularly in harbors or other confined waters. Drilling will produce localized water turbidity of short duration as drill cuttings are disposed of at

the site. Loss or disposal of drilling mud will affect water clarity temporarily. Pipeline construction will result in temporary turbidity, particularly where burial is required. Platform placement will affect visual quality and is discussed during the production phase. Vessels and flaring will produce the same impacts as discussed in the preceding exploration section.

Onshore activities during this phase will involve platform and barge construction, treatment and storage facility construction and equipment storage yards. A secondary impact occasioned by the interaction between regional increased product demand and the ready availability of crude supplies, may be the construction of refineries. Platform construction will take place in dry docks, probably in heavily industrialized areas where it will constitute little additional visual impact. If construction facilities are developed in what is now open area, the land use change involving dredging and filling plus the clutter of the structure itself and associated cranes would be a considerable impact. Barge or tanker construction will probably take place in the industrialized sector of Los Angeles-Long Beach or San Francisco Bay and thus not constitute much of an impact. Treatment and storage facilities are usually placed as close to the wells as possible which indicates either platform location or nearby shorelines. This is due to the difficulty in moving multi-phase materials through pipelines. Placement of these facilities on platforms would add somewhat to the bulk of the structures but would not appreciably affect their visual impact.

Santa Rosa, the Santa Barbara Channel and the Santa Barbara Island groups of tracts are located proximate to various Channel Islands. The northern edge of the Tanner-Cortes area lies 15 miles south of San Nicolas Island. All of these islands are largely to totally undeveloped and present views which are rare in Southern California, that of primarily native vegetation on unaltered hillsides. In addition, many of them have the unique biological assemblages alluded to earlier. The placement of facilities on these islands constitutes the greatest single impact potential in terms of alteration of natural regimes, thereby changing the esthetic environment. Visual impact could range from high to low depending upon the sensitivity of siting, earthwork quantities, jetty construction, structure design, use of colors and subsequent landscaping. Placement of these facilities in highly populated shoreline areas would affect far greater numbers of people but would effect much less change in the existing conditions than would use of islands. This is particularly true in portions of San Pedro Bay where the shoreline is already heavily industrialized and little change would be evident with the addition of more facilities. In the Orange County portion of the San Pedro Bay tracts, the shoreline is either undeveloped or primarily recreational-residential. Siting of facilities in these areas would present a visual as well as an olfactory impact. The

duration of the impact would equal the life of the field or about 20-40 years. Boaters would be able to view these facilities if they are sited near the shore. We estimate that those people who listed cruising, sailing or fishing as their main boating pursuits, will in some way be affected by these facilities. Based on this, approximately 2,000,000 visitor days will be in some way affected. No estimate will be made of the number of viewers who will be affected as residential viewers or as passersby on the Coast Highway and nearby streets.

If refinery construction should occur, resulting from a secondary or tertiary effect of this proposal, then due to the restraints of existing air quality, available land and crude oil transportation costs, such construction is unlikely to take place in the Los Angeles Metropolitan area. The most probable location would be in the near-coastal areas of Ventura County. Alteration of land use there, from predominately agricultural to heavy industrial would constitute a considerable esthetic alteration and be nearly universally perceived as adverse. Visual clutter, noise and odors would result. Some air quality degradation would occur thus affecting areas many miles from the source. Land use changes of this type are likely to spawn additional industrialization and be permanent in duration.

Accidents during the development stage might include loss through sinking or stranding of platforms and vessels. The impacts would be visual in the form of wreckage which might not be salvaged and oil spillage. Loss of platforms is construed as some accident occurring while the structure is being towed from a construction site to an installation site. Visual disruption of beaches or estuaries will exist for several months after pipeline construction. Pipelines may also leak. Oil spill dangers from barges and well blowouts persist through this phase. These risks are considered as a composite of the whole program in the following section's discussion of production. Flaring with poor combustion will produce heavy particulates whose noticeable persistence will be on the order of a few hours following cessation of the activity.

Onshore events could result in impacts like landsliding at installations and spillage of noxious or toxic substances stored or utilized there. These events are highly unpredictable and speculative, thus no quantification of impacts is made.

Production is the main phase of this proposal and will last for about 20-40 years for individual fields. Production will probably cease about 2020 for shallow water portions of this proposal and extend to 2040 for the deepwater areas.

Impact producing elements during normal operations will include permanent features like platforms, pipelines, treatment and storage facilities in the offshore. Periodic significant oil spills will

occur from wells, pipeline breaks and barges. Low level spillage will be constantly present. Barges and work boats will add to congestion. Periodic transitory increases in turbidity will arise from mud lost or discarded during well workover and maintenance, and from sediment suspension in pipeline maintenance work. The presence of nearby platforms will infringe upon the solitude of the sea causing esthetic degradation for some.

Platforms will cause the longest lasting most prominent visual esthetic impact wherever they are installed. Visual impacts can be viewed in two ways: 1) impacts increase in magnitude when they occur in a totally natural environment or 2) impacts increase in magnitude when they are visible to greater numbers of people. Under these criteria, platforms on the Tanner-Cortes or Santa Rosa areas would produce a greater impact under Criterion 1 while they would produce a greater impact in the nearshore mainland and some island waters under Criterion 2. Both criteria in combination are valid because we are analyzing these impacts in terms of the human environment, thus supporting Criterion 2 where numbers become important, while simultaneously recognizing the value of an environment untrammelled by great numbers of humanity and unencumbered by his physical accouterments as is suggested in Criterion 2.

Visibility plays an important role in the visual impact of platforms. The best visibilities occur in January but in most cases the January-July spread is only a few percentage points. Platforms, without regard to relative size, may be visible according to Table III.E.12-1.

Table III.E.12-1

REGIONAL VISIBILITIES BY PERCENT OF OCCURRENCE

% of observations with visibility exceeding 5 n. or 10 miles

Zone	January 5	January 10+	July 5	July 10+
W. Santa Barbara Channel	89%	59%	91%	52%
E. Santa Barbara Channel	96%	85%	48%	8%
Santa Cruz Isl.	93.5%	61%	91%	50%
Santa Monica	88%	58%	87%	37%
San Pedro	71%	22%	76%	31%
Catalina Island	91%	57%	90%	41%
Costa Mesa	92%	63%	70%	38%
Dana Point	91%	48%	83%	83%
San Diego	86%	46%	89%	35%

% of observations with visibility exceeding 7 n. miles

Pt. Mugu	
January	76
July	53

Some portion of a one hundred-ninety foot structure can be seen from eye level at the water's edge if it is located 17 miles or less from shore. From elevated vantage points it is often possible to see several of the offshore islands at a great distance. All of the northern Channel Islands are visible from the Santa Barbara coast. In the Santa Monica Mountains, Anacapa, Santa Cruz, Santa Barbara and Catalina Islands can be seen. In Orange County, Catalina and occasionally San Clemente Islands are visible. This means that all of the proposed tracts within the Santa Barbara Channel, Santa Barbara Island and Dana Point-San Diego areas are visible from portions of the mainland costal area during portions of the year. At distances of 20 miles and beyond, the size of platforms would appear very small. Apparent size in combination with haze would render the visual impact of platforms at those distances nil.

Platforms placed in the Santa Barbara Channel are visible much of the time from nearly all mainland coastal viewpoints. They are fairly prominent objects exhibiting discordant vertical and angular lines and contrasting tone against the soft flat plane of the sea. Those within ten miles of shore are moderately prominent objects. Nowhere are they framed by a background of similar appearance and they affect the view considerably in some areas.

In San Pedro Bay, platforms will be viewed against an already industrialized cluttered skyline in the Los Angeles-Long Beach Harbor area. Viewed from the other direction, they may tend to be obscured by the presence of Catalina Island in the background. In Orange County, offshore oil development exists in State waters as far south as Huntington Beach, thus platforms in Federal waters would constitute much less of a contrast with existing conditions than they would in areas now devoid of artificial islands or platforms. From Huntington Beach south to San Diego, the visual impact is increased because of no existing offshore development and because the shorelines are less developed and not industrialized.

Approximately 85 million visitor days are expended annually at the coast of Ventura, Los Angeles and Orange Counties. If approximately 27 percent of those are engaged in sightseeing as a major activity, then 22,950,000 visitor days are going to be affected to some degree by esthetic alteration in coastal waters. Adjusting this figure for lowered visibility indicates an annual impact of more than 19,000,000 visitor days without adjustment for annual growth in use. The state predicts an increase in demand of 30 percent to 1980 and 32 percent from 1980 to 1990 for the affected portion of the coast.

In addition to beach users, who may originate locally or from distant points, there are numerous residents whose view will be affected by structures as often as visibility permits for the duration of the field's life. This impact cannot be quantified without knowing the number of viewers, the nature of their perception and intensity of their reaction to the change in their view. The number of those affected, without regard to the nature of their reaction will be extremely large when computed over the project's life.

Numerous users of the Coast Highway and ocean front streets will be affected by esthetic changes. Realizing that there is overlap between beach, residential and highway users, we estimate a large additional increment of impact for the driving public.

Santa Barbara Island tracts may occasionally be visible from the mainland but platforms would appear very small and indistinct if discernible at all. Viewers on the island and boaters would see platforms rather readily. The only population concentration on the islands is at Avalon on the far end of Catalina from these tracts.

Large numbers of boaters use the waters around Catalina and many clubs maintain anchorages in coves on the island's north side. These people would be affected in a minor way. Santa Barbara Island is part of the Channel Islands National Monument and receives visitation from private recreational boaters and commercial carriers. Total visitation to the monument is about 106,000 which we will allocate evenly between Anacapa and Santa Barbara Islands. Due to the difficulty of access to the island, the casual recreationist is largely not present. We feel that most of the visitors are therefore primarily interested in the island's scenic and natural values and consequently susceptible to the visual impact of platforms and support vessels. There is pristine ocean around Santa Barbara Island, thus a large potential impact. No State oil sanctuary exists at Santa Barbara and, consequently, although one is proposed, no buffer in Federal waters adjoins the State waters. Platforms could be erected within 4.8 km (3 miles) of the island itself and less than 3.2 km (2 miles) from the Monument boundary. If this circumstance ensued, the visual character of the Monument would be greatly altered. Approximately 53,000 visitor days annually would be affected with 2,385,000 visitor days affected for the life of the proposal. This makes no allowance for the inevitable annual growth in visitation. We have no estimate of the number of boaters passing through these tracts but it is likely that a significant percentage of Southern California boaters do use this area at least occasionally.

The Santa Rosa area is exposed to few permanent residents. Its visual impact will be on boaters primarily. Many Santa Barbara area boaters use the waters surrounding the northern Channel Islands for weekend day use and overnight outings. The only viewers will be boaters and the residents of Johnson's Lee, a small military installation on the south side of Santa Rosa Island. Both the islands and the surrounding sea are nearly pristine and thus the potential impact is large. However, the nearest tract in this proposal is at least 9.7 km (6 miles) from shore, therefore, any platforms would be distant and fairly small in apparent size.

The Tanner-Cortes area tracts are far removed from any land based viewing position, lying a minimum distance of 24 km (15 miles) south of San Nicolas Island. San Nicolas has a naval installation with a few permanent residents. It is used by pinnipeds for hauling out and rookeries. Boaters would be the major viewers and most of them are there to fish and scuba dive. Industrialization of San Nicolas could affect the esthetic resource and through driving away the pinnipeds. Esthetic impacts would be the lowest on these tracts when compared to all others proposed.

Esthetic values will be impacted by accidental events which are statistically bound to happen. These will occur during drilling, well operation, storage of production, transportation and maintenance.

Fires, leaks and spills will result, with concomitant visual and biological effects. Normal operations will result in some floating debris being cast upon beaches. This will constitute an esthetic loss for those affected.

Chronic spillage at low levels will continue throughout the life of the proposed action resulting in small slicks visible to boaters or tar balls cast up on beaches. Natural sources of oil already contribute to this type of pollution and it may be difficult to separate the two. The existing situation will be somewhat exacerbated. Noise from pumping stations and other operations will constitute an esthetic impact. Fires will reduce air quality on a temporary basis and often have associated oil spills.

Spills greater than 50 bbl from all sources will occur with spills in excess of 1,000 bbl being probable. These have the potential of affecting several million visitor days over the life of this proposal. Most effects are temporary in duration, although the lost opportunity is irretrievable. Permanent effects could ensue if certain biological resources were destroyed or if land changes from natural conditions to industrial in conjunction with this proposed sale persisted after abandonment of the fields, as is likely.

During the final stage, abandonment, there is some risk of oil spill, but it is low. Removal of equipment will result in noise and increased traffic, temporarily. Placement of scrap equipment on land may cause an esthetic impact. Nothing visible should remain in federal offshore waters after abandonment, as Federal Regulations require total removal of equipment to below the mudline.

b. Impacts on the Southern California Bight From Oil Spills: A total risk of 5 oil spills greater than 1,000 bbl is predicted for the life of this proposal. Where these occur and the route they take is going to greatly affect the amount of impact they cause. If they strike heavily used or very beautiful beaches or cliffs, then the impact could be severe, though mostly temporary. If industrial or inaccessible areas are struck, then the impact is lessened.

i. Santa Barbara Channel Area Impacts: Segments 28 to 31 are considered to be the mainland coast of this area for this analysis. A total of 3.1 incidents of spills greater than 1,000 bbl (large spills) is predicted for this area from proposed Sale No. 48. The model predicts chances ranging from 1 to 15 percent that a large spill will occur and contact one of these segments. Segment 28 has the only significant risk at 15 percent. This segment is on the Ventura County coast. This is a sandy coast having wildlife values and moderately heavy use. The calculated impact for an incident is 30,800 loss in visitation. For the predicted number of incidents striking this segment, the total loss is 95,500. For the northern Channel Islands, the impact chance rises precipitously to 53 percent for Segment 49 (Santa Cruz Island). Segment 50 (Anacapa

Island) has a 23 percent risk level while Segments 47 and 48 (San Miguel and Santa Rosa Islands) have risks of 14 and 19 percent, respectively. Since boating use data are not available, the impact potential cannot be quantified for the larger islands. Anacapa Island would probably lose about 42,400 visitation.

Segment 27 (Zuma Beach to Santa Monica) is exposed to a risk of 31 percent. A resource of great importance exists in this heavily utilized and scenic area. A single incident loss in this area would be 304,000.

ii. San Pedro Bay Area Impacts: Segments 24 to 26 are included in this discussion. Only Segments 26 (Santa Monica Bay) and 53 (Catalina Island) have a significant risk which is 22 percent. A single incident striking Segment 53 could equal a loss of 2,596,000 visitation. Catalina would lose about 6,100 visitation.

iii. Dana Point-San Diego Area Impacts: Segments 21 to 23 are included. None suffer a risk exceeding 8 percent; therefore, no loss potential is computed.

iv. Santa Rosa Area Impacts: There is no way of computing impacts without data on boater use of the area and this is not available.

v. Tanner-Cortes Area Impact: See comment for Santa Rosa Area.

vi. Santa Barbara Island Area Impacts: Segment 52 is Santa Barbara Island and the risk of a large spill contact is 5 percent. The single incident impact is the same as for Anacapa Island but is not computed because the risk is not significant.

vii. Baja California: The risks of a large spill contacting any one of these segments is less than 10 percent; therefore, no impacts are computed.

viii. Tankering Impacts: Segments 32 to 46 are included in this section. All segments have a risk of 5 percent or lower; therefore, no impacts are computed.

c. Cumulative Impacts: Santa Barbara Channel Area. The risk for all projects raises Segments 28 to 37 percent and the islands to between 36 and 88 percent. For Segment 28 the computed impact may be 40,000 and for Anacapa Island, 84,800 visitation. Without data for the other islands, impacts cannot be quantified. For Segment 26, the cumulative risk rises to 51 percent, with most of the risk appearing to be attributable to Tanker Leg 8.

i. San Pedro Bay Area: The risk to Segment 24 is negligible but rises to 16 and 51 percent, respectively, for Segments 25 and 26. A total of 4.96 spills is predicted for this area and this could produce an impact of 12,900,000.

ii. Dana Point-San Diego Area: The risk rises to 17 percent for Segment 21, and 11 and 13 percent for Segments 22 and 23, respectively. The total predicted loss is 12,600 for the three segments.

iii. Santa Rosa and Tanner-Cortes Areas: Without use data, potential impacts cannot be quantified.

iv. Santa Barbara Island Area: The risk rises to 14 percent. At a predicted spill rate of 0.47, the impact would be 19,900.

v. Baja California: None of the cumulative risks rise to 10 percent or more for any individual segments, thus the risk is not considered significant.

vi. Tankering Leg Impacts: Segment 32 at 19 percent risk and 42 at 13 percent are the only ones exposed to a significant risk. The cumulative loss for Segment 32 is less than 100 and 9,100 for Segment 42.

13. Onshore Cultural Resources: Terrestrial cultural resources may be affected by this proposal by construction activities and oil spills through direct physical contact and associated cleanup activities. Physical and visual impacts will occur.

Physical disruption would occur if construction activities took place on undetected or ignored cultural resource sites. The severity of the impact would vary with the significance of the resource and the level of damage or disruption. It is probably reasonable to assume that State EIR requirements would be mitigatory in most areas. These types of impacts would arise from pipeline construction and burial and other construction such as operations bases. The presence of workers and supervising staff in the area enhances the prospects for pot-hunting and vandalism.

Cleanup activities using heavy equipment could result in damage to cultural resource sites located in the surf zone, upper splash zone or beach and bluff areas. Picking up sorbents or sand with heavy equipment may damage sites, although those exposed to swells or waves may already be reworked in the shallowest layers. Many examples in Alaska's Cook Inlet and at least one off Florida evidence the ability of some sites to survive the passage of rising waters and the surf zone. Construction of roads necessary to reach shoreline areas with equipment could affect sites in dune or bluff areas. Due to the crisis atmosphere sure to ensure following a spill, adequate survey or site marking prior to cleanup activity is unlikely. The impact potential depends upon the number of sites at the strand and the spill risk to particular shoreline segments. The last physical impact possibility is the contamination of porous materials by hydrocarbons. This could interfere with radiocarbon dating and affect the appearance of the material.

Additional to physical impacts are visual impacts which could result from construction of facilities, installation of platforms and oil spill contamination.

A great risk to cultural resources and particularly historic or architectural/engineering samples, is induced land-use change which results in razing of significant and perhaps unrecognized structures. Changes in the surroundings also affect objects, structures or sites by changing the surroundings or area's "character."

a. Impacts on the Southern California Bight: Numerous coastal or near coastal aboriginal sites dot this coast. They are concentrated primarily along the Santa Barbara-Ventura County coastline with lesser concentrations in the Point Dume and northern San Diego County shoreline. The impacts from spills may range from

minor to severe. In cases where some oil or tar balls may soil rocks along the surf zone at the base of a 25 m (82 feet) bluff, the effect on cultural resources at its top is obviously temporary and minor.

The placing of platforms on tracts nearer to shore may affect the visual environment. However, since the nearest a platform would likely be to the coast is 4.8 km (3 miles) and since most sites do not derive their significance because of their dominant sea view, this is not expected to be a major impact and it will be temporary, lasting only for the life of the lease, or about 20 years.

The area of potential environmental effect (APEE) is that area of the coast from which offshore views of proposed lease tracts may be had. It is further restricted to a distance offshore of 25 km (15.5 miles) from the cultural resource sites. Beyond this distance, the apparent size of any structure would cause it to be little noticed in the total view of the significant cultural resource site. Between 12 km (7.5 miles) and 25 km, the structures become more noticeable, though still not dominant. For oil spills, the APEE is restricted to the area reached by waves and tides and exposed to heavy equipment.

b. Santa Barbara Channel Area Impacts - Santa Barbara County: There are no National Register sites or sites determined to be potentially eligible for inclusion in the National Register within the APEE of this proposal. There are three sites within the APEE which are identified as significant by the State or local groups and which may, consequently, qualify as potentially eligible for the National Register. These are the light station and railroad station sites at Point Conception, and the Santa Barbara Lighthouse.

The sites on Point Conception cap cliffs that are about 25 meters (82 feet) high. As a consequence, any spills impacting the rocks at the base of these ought not to be considered a significant impact. The Santa Barbara Lighthouse is on a 36 m (118 foot) bluff, which places it well above the influence of spilled oil. Structures on all or portions of the following tracts fall within a 25 km (15.5 miles) range: 2-6, 8-12, 13-18, 21-26, 31-38, 48-54. Visual effects may be noticeable on the following tracts which are within 12 km (7.5 miles) of the sites: 5, 6, 11, 12, 16, 17, 24, 25. Visual effects may be evident within the following tracts lying within 25 km (15.5 miles): 19, 20, 28-30, 44-47, 61-64, 74, 86. Only the extreme northwest boundary of Tract 63 lies within the 12 km (7.5 miles) zone. The greater incidence of fog in this region is an ameliorating effect. Visual effects are not expected to be significant.

Numerous archeological sites dot the Santa Barbara coastline, some of which may be exposed to oil spills or cleanup activities. Segments 30, 31 and 32 have a respective risk of being contacted by an oil spill of 1, 1 and 4 percent for 10-day trajectories and 5, 1 and 3 percent for 60-day trajectories.

Ventura County. There are no National Register sites or sites determined to be potentially eligible for inclusion in the National Register within the APEE. There are three sites within the APEE which have been identified by State or local organizations which may qualify as potentially eligible for inclusion in the National Register. These are: Port Hueneme Old Wharf Site, Seaside Hotel-Port Hueneme and San Nicolas Island. Visual effects are expected to be limited with only Tract 87 within 12 km (7.5 miles) and Tracts 65, 75, 76, 87, 106-108 within 25 km (15.5 miles). San Nicolas Island is a vast repository of archeological material and has several sites which could be affected by either spills or cleanup activities. San Nicolas is designated as Segment 51 in the spill model and runs a predicted risk of oil spill occurrence and impact ranging from 6 percent for a 10-day trajectory and 12 percent for a 60-day trajectory. The source is most likely launch points P10 (16 percent at 10 days and 19 percent at 60 days) and P12 (4 percent at 10 days and 10 percent at 60 days). No visual impacts from structures are expected. There is at least one minor site on Anacapa Island which is exposed to waves, and the probability of a spill occurring and contacting this island is 20 percent and 23 percent, respectively, for 10 and 60 days.

Numerous archeological sites exist on Segment 29 portion of the coast and a few on Segment 28. A few of these may be vulnerable to spills or cleanup activity. The risk for Segment 28 ranges from 12 to 15 percent for 10 and 60-day trajectories. Segment 29 risks are 3 percent for all trajectories of 10 days or greater. Launch point P8 is the highest potential risk source if a spill occurs.

Los Angeles County. The following National Register sites are within the APEE: Adamson House, Battery Osgood-Farley, Humaliwo, Point Fermin Lighthouse, and the SS Catalina (recently moved). There are no sites determined to be potentially eligible for inclusion in the National Register within the APEE. Other sites which are within the APEE and may qualify as potentially eligible for inclusion in the National Register are: Old Saint Peter's Episcopal Church (San Pedro), Santa Monica Pier, Timm's Point and Landing (San Pedro), Wayfarer's Chapel (Portuguese Bend) and Whaling Station Site (4 km (2.5 miles) east of Point San Vicente). There are archeological sites in the Zuma to Malibu area and Palos Verdes.

Visual alteration could occur for Battery Osgood-Farley (NR), Point Fermin Lighthouse (NR), Old Saint Peter's Church and Wayfarer's

Chapel. Within 2 km (15.5 miles) the Battery, the Church, and the Lighthouse are parts or all of Tracts 120-125, 125-128. All or portions of Tracts 120-123 are within 12 km (7.5 miles). Visual alteration of the environment may occur but the effects are not expected to be permanent nor significant. Within 25 km (15.5 miles) of the Wayfarer's Chapel and the Whaling Station and potentially visible from it are Tracts 120, 121, 123, 125, 126-128. Only Tract 120 is within 12 km (7.5 miles). The visual alteration potential is lower than for the preceding sites discussed due to increased distance and terrain blocking.

Oil spills may affect the property upon which Adamson House (NR) and Humaliwo (NR) rest if the property extends to the strand. The chance of a spill contact occurring in this segment is 25 percent for a 10-day trajectory and 31 percent for a 60-day trajectory. The other north County archeological sites are in this segment and some may be exposed to spill or cleanup activities. The greatest risk source to this segment is from tankering (Legs T7 and T8). Timm's Point, the Whaling Station and Santa Monica Pier in Segment 26 are exposed to a 20 percent risk of a spill contact for a 10-day trajectory. Timm's Point and Landing is probably of lower risk than the others. A spill is not likely to produce a lasting effect on the pier.

Orange County. Lowell Beach House is the sole National Register site within the APEE. There are no sites determined to be potentially eligible for inclusion in the National Register in the APEE. McFadden Wharf on Balboa Peninsula is the only site within the APEE possibly qualifying as potentially eligible for inclusion on the National Register. There are only two archeological sites which may be exposed to oil spills or cleanup activities.

Visual alteration within 25 km (15.5 miles) may occur from Tracts 122, 124, 128-131, 133-143 and within 12 km (7.5 miles) from Tracts 130, 131, 136, 137 for both the Beach House and the Wharf. The spill risk is predicted at no higher than 1 percent.

San Diego County. The following National Register Sites are within the APEE: Cabrillo National Monument, Hotel Del Coronado, Initial Point of the Boundary between U.S. and Mexico, Old Point Loma Lighthouse and George H. Scripps Memorial Laboratory. There are no sites determined potentially eligible for nomination to the National Register within the APEE. The following sites within the APEE may be of enough significance to qualify as potentially eligible for nomination to the National Register: Ballast Point, Fort Guijarros Sites, Fort Rosecrans, San Diego Whaling Station (near Ballast Point).

Alteration of the visual environment may occur for Hotel Del Coronado, Initial Boundary, Lighthouse, Cabrillo N.M., and Scripps Lab. Scripps Lab has no tracts within 12 km (7.5 miles) and Tracts 154-157, 159 and 161 are within 25 km (15.5 miles). Cabrillo N.M. and the lighthouse on the site are within 12 km (7.5 miles) of Tract 166 and within 25 km (15.5 miles) of Tracts 155, 156 and 158-166. The hotel and boundary point are further than 12 km (7.5 miles) from any tract, but Tracts 165 and 166 are within 25 km (15.5 miles) of both sites. Visual alteration of these sites by structures on the tracts is not expected to be significant except for Tract 166 which is only 9.5 km (5.8 miles) from Cabrillo N.M.

Spill risk for this area does not reach significant levels (10 percent).

c. Baja California Impacts: The spill risk to the Baja California segments do not, individually, reach significant levels.

d. Tankering Leg Impacts: The spill risk to these coastal area segments, individually, does not reach significant levels.

e. Cumulative Impacts

<u>Santa Barbara Channel</u>. Spill risks and cleanup activity threaten aboriginal archeological sites but no historic sites. The combined risk from existing and proposed leases is no higher than 9 percent for a 10-day trajectory for Segments 29-32. Risks do not exceed 8 percent for a 60-day trajectory, except for a 19 percent risk in Segment 32. On the other side of the channel the 10-day trajectory risk rises to 27 to 86 percent. The 60-day risk ranges from 31 to 88 percent. Santa Rosa and Santa Cruz Islands have the greatest number of sites and consequently the highest likelihood of having spill susceptible sites. The risk for Santa Rosa is 44 percent for a 10-day trajectory and 50 percent for a 60-day trajectory. Santa Cruz Island has a 52 percent risk for a 10-day trajectory and an 88 percent risk for a 60-day trajectory. This indicates that the greatest damage potential for archeological resources is on the Channel Islands; however, most of the sites, save for those eroding from cliffs or bluffs, are on the upper terraced areas rather than the restricted strand existing around most of the islands.

<u>Ventura County</u>. The cumulative risk for this is 32 and 37 percent for 10 and 60-day trajectories, respectively.

<u>Los Angeles County</u>. The cumulative risk for these segments are:

Segment	10-day trajectory	60-day trajectory
25	14 percent	16 percent
26	47 percent	51 percent
27	56 percent	66 percent

If vulnerable, the risk from spill contamination is quite significant for the Adamson-Humaliwo Site, but the risk of equipment damage is probably low. The Santa Monica Pier would not be damaged by oil, but the sandy beaches which comprise its setting would be.

Orange County. The combined risk rises to only 4 percent for a 60-day trajectory; therefore, neither Lowell Beach House (NR) nor McFadden Wharf is seriously threatened.

Dana Point-San Diego. The combined risk for a 10-day trajectory is less than 6 percent for Segments 20 to 23. For a 30-day trajectory, the risk is 17, 11 and 13 percent for Segments 21-23. This poses a moderate risk of spill soiling of the Coronado Hotel, Cabrillo National Monument and the 4 sites in the Ballast Point vicinity. The Ballast Point sites are relatively safe because they are well into the Bay entrance. The risk to Cabrillo N.M. is that of soiling the intertidal area and the risk to the hotel is that of soiling the wide beaches fronting the site. The hotel probably has the greatest impact potential of any of the Segment 21 sites, and even in this case, the structure is not threatened. The risk in Segment 22 is barely significant at 11 percent and would affect the intertidal portion of the site upon which the Scripps Memorial Laboratory sits.

Baja California. No segment reaches significant risk levels (10 percent or greater).

Tankering Leg. Segment 42 at 13 percent risk for a 60-day spill is the only segment with a significant risk. In this San Mateo County coastline area are Pigeon Point and Point Montara Light Stations. Pigeon Point is in the National Register and Point Montara has been declared eligible for inclusion in the National Register. Pigeon Point is atop 9 m (30 foot) cliffs which means that oil soiling of the site would temporarily affect the visual environment. Point Montara Light is atop 18 m (60 foot) cliffs and less vulnerable to spill-occasioned visual alteration than Pigeon Point, but it retains some degree of vulnerability. Cliffs at both sites are very steep and rocky and thus not readily amenable to cleaning due to difficulty of access.

Summary

With the current state of knowledge concerning underwater cultural resources, quantified data are not available; therefore, the impact potential cannot be computed in numerical terms. It appears likely that even with diligently pursued surveys, some cultural resources may remain unfound and some of these will be damaged or destroyed. With lessening effectiveness in surveys and/or evaluations, the potential for loss increases. Aboriginal sites appear to be more susceptible to loss than shipwrecks.

14. Impact on Population: The impacts on population data is based on the Curtis Harris Economic Model runs conducted for this Environmental Statement. This section discusses the most probable population changes associated with proposed Sale No. 48 related development (Table III.E.14-1). For a more detailed discussion of the Curtis Harris Economic Model and the inputs and outputs used in this analysis, see: POCS Reference Paper No. IV.

Population changes result due to net migration (in minus out migration) and natural increases in population, that is, births minus deaths. Migration is largely determined by the availability or lack of availability of jobs in an area. It is important, therefore, to show the projected increases in jobs that will result due to this proposed sale. If the sale is held in 1979, jobs in the five Southern California counties of San Diego, Orange, Los Angeles, Ventura and Santa Barbara, are projected to increase by 711 in 1980, reaching a peak of 15,217 in 1986 and leveling out to 8,137 by the year 2000. These jobs include both direct employment and jobs generated by secondarily induced effects. A detailed discussion of employment impacts are discussed in Section III.E.15., Impacts on the Economy.

Net migration for the five-county area is projected to increase by 1,585 in 1980 and reach a peak of 24,206 in 1985, decline to 8,089 in 1986 and result in a net of minus 2,349 in 1990, net migration increase to a minus 13,330 in 1995 before leveling off at a minus 861 in the year 2000 (Table III.E.14-2).

The total population change, that is, natural increases and migration for the five-county area is projected to be 1,585 in 1980, reaching a peak of 34,451 in 1986 and leveling off at about 20,000 in the 1995 to 2000 period. That is an increase of 0.01 percent of the California Department of Finance population projection for 1980 (11,698,400), 0.28 percent of the projected 1985 population (12,508,200) and 0.14 percent of the 1995 projected population of 14,028,200 (Table III.E.14-1 and 2).

Los Angeles County population changes are minor over the life of the project. The peak population increase is projected to be 9,956 in 1986. That is an increase of about one-tenth of one percent of the projected population of 7,377,900 for the county during 1985 (Table III.E.14-3). Some of the population increase is projected to come as a result of migration into the county. In-migration is projected to be 283 in 1980, peak at 7,839 in 1985 and result in out-migration of 494 in 1990, peak out-migration of 2,354 is reached in 1995 before leveling at about 200 from 1995 to 2000. The indication is that some of the workers drawn to Los Angeles County as a result of proposed Sale No. 48 activity will leave when activity begins to decline. However, of the total in-migration, more than one-half will make Los Angeles County their permanent residence.

Table III E.14-1

MOST PROBABLE
POPULATION CHANGES DUE TO PROPOSED SALE NO. 48
RELATED ACTIVITY

County	Year					
	1980	1985	1986	1990	1995	2000
Los Angeles	282	8,197	9,956	9,792	7,735	7,749
Orange	-8	263	248	-39	-275	-1,038
San Diego	136	2,810	3,172	3,221	3,038	3,528
Santa Barbara	326	2,945	3,498	2,257	1,268	1,283
Ventura	849	11,951	17,577	17,865	8,755	8,614
So. California Totals	1,585	26,166	34,451	33,096	20,521	20,136
Alameda	-7	-468	1,208	1,065	1,841	1,757
Contra Costa	1	196	349	582	181	-107
Marin	0	-30	-32	-43	-90	-237
Monterey	-3	29	30	93	114	131
Napa	-2	-27	-29	-17	-8	-5
San Francisco	9	-50	-48	153	-321	-1,135
San Luis Obispo	-1	-21	-23	-20	-32	-44
San Mateo	1	-122	-149	-314	-2,002	1,072
Santa Clara	-26	-363	-404	-317	-492	-479
Santa Cruz	-2	-30	-27	-10	-12	-31
Solano	0	530	-520	-543	-589	-274
Sonoma	-2	14	10	-18	-87	117
Central California Totals	-32	-342	365	611	-1,497	765
17 Coastal Counties Totals	1,554	25,826	34,817	33,706	19,024	20,900
California Totals	1,546	24,527	34,426	28,460	20,930	20,582

Table III E.14-2

MOST PROBABLE NET[a]
POPULATION MIGRATION DUE TO PROPOSED SALE NO. 48
RELATED ACTIVITY

County	Year					
	1980	1985	1986	1990	1995	2000
Los Angeles	283	7,839	1,701	-494	-2,354	-177
Orange	-8	271	-16	-289	-234	-759
San Diego	135	2,626	336	-73	-224	404
Santa Barbara	326	2,583	532	-1340	-1,039	-5
Ventura	849	10,887	5,537	-161	-9,457	-303
So. California Totals	1,585	24,206	8,090	-2,357	-13,308	-840
Alameda	-7	-456	1,678	-136	786	-93
Contra Costa	1	195	153	227	-403	-286
Marin	0	-29	-2	-10	-45	-146
Monterey	-3	33	1	61	15	12
Napa	-2	-25	-2	12	9	3
San Francisco	9	-58	2	202	-474	-810
San Luis Obispo	-1	-20	-1	4	-11	-11
San Mateo	1	-123	-27	-164	-1,689	3,077
Santa Clara	-25	-331	-38	100	-161	24
Santa Cruz	-2	-27	3	17	-1	-19
Solano	0	533	-1,050	-23	-42	324
Sonoma	-2	16	-4	-29	-68	204
Central California Totals	-31	-292	713	261	-2,084	2,279
17 Coastal Counties Totals	1,554	23,913	8,801	-2,097	-15,390	1,441
California Totals	1,545	22,633	9,717	-6,936	-8,201	-790

[a]In-migration minus out-migration

Table III E.14-3

MOST PROBABLE PERCENTAGE
POPULATION CHANGES DUE TO PROPOSED SALE NO. 48
RELATED ACTIVITY ON PROJECTED POPULATIONS

County	Year					
	1980	1985	1986[a]	1990	1995	2000
	%	%	%	%	%	%
Los Angeles	0.00	0.11	0.13	0.13	0.10	0.10
Orange	-0.00	0.01	0.01	-0.00	-0.01	-0.04
San Diego	0.01	0.14	0.15	0.14	0.12	0.13
Santa Barbara	0.11	0.93	1.10	0.67	0.36	0.35
Ventura	0.17	2.05	3.01	2.69	1.18	1.06
So. California Totals	0.01	0.21	0.28	0.25	0.15	0.14
Alameda	-0.00	-0.04	0.10	0.09	0.15	0.01
Contra Costa	0.00	0.03	0.05	0.08	0.02	-0.01
Marin	0.00	-0.01	-0.01	-0.02	-0.03	-0.08
Monterey	-0.00	0.01	0.01	0.03	0.03	0.03
Napa	-0.00	-0.02	-0.02	-0.01	-0.01	-0.00
San Francisco	0.00	-0.01	-0.01	0.02	-0.05	-0.18
San Luis Obispo	-0.00	-0.01	-0.01	-0.01	-0.02	-0.02
San Mateo	0.00	-0.02	-0.02	-0.05	-0.31	0.16
Santa Clara	-0.00	-0.03	-0.03	-0.02	-0.03	-0.03
Santa Cruz	-0.00	-0.01	-0.01	-0.00	-0.00	-0.01
Solano	0.00	0.21	-0.21	-0.19	-0.18	-0.07
Sonoma	-0.00	0.00	0.00	0.01	-0.02	0.03
Central California Totals	-0.00	-0.01	0.01	0.01	-0.03	0.01
17 Coastal Counties Totals	0.01	0.14	0.19	0.18	0.10	0.10
California Totals	0.01	0.10	0.14	0.11	0.07	0.07

[a]Percentage increase based on projected 1985 population.

Orange County population changes are projected to be insignificant over the life of the project. Peak population increases are projected to be 248 in 1986. That is a one-hundredth of one percent increase of the projected 1985 population of 2,173,400. Net migration for Orange County is also projected to be impacted insignificantly. Net population migration is projected to be +271 in 1985, dropping to -16 in 1986, -289 in 1990, -234 in 1995 and -759 in the year 2000 (Table III.E.14-1, 2 and 3).

San Diego County population changes are projected to be minor as a result of proposed Sale No. 48 related activity. Peak population increases are projected to be 3,528 in the year 2000. That is about a tenth of one percent (0.13 percent) increase of the projected 2000 population of 2,663,800. During the peak production year of 1986, population is projected to increase by 3,172; that is a 0.15 percent increase of the 1985 projected population of 2,055,700 for San Diego County. Although population is projected to increase thoughout the life of the project, net migration will vary. During 1980, net migration is projected to be +135, rising to +2,626 in 1985, declining to +336 in 1986, -73 in 1990, -224 in 1995 and up to +404 in 2000. All of these changes are minor compared to the total population of the county (Table III.E.14-1, 2 and 3).

Santa Barbara County population changes are projected to be significant during the peak development years of 1985 and 1986. Peak population increases of 3,498 are projected for 1986; that is a 1.1 percent increase of the projected 1985 population of 317,100 for Santa Barbara County. Population increases are minor in 1980 (0.11 percent) with a 326 rise. By 1985, however, population increases of 2,945 (0.93 percent) are projected over the 1985 projected population of 317,100. The rate of increase declines to 0.67 percent in 1990 with a 2,257 rise, before declining to about 1,300 for the 1990 to 2000 period. That is about a 0.4 percent increase in the 1990 to 2000 period. Much of the population increase during the peak years of activity are projected to be a result of in-migration. Net migration is projected to be +326 in 1980, rising to +2,583 in 1985, declining to +522 in 1986, resulting in out-migration of 1,340 in 1990, net migration of -1,039 in 1995 and -5 in the year 2000. The model results indicate that much of the labor force required for peak years activity will come into the county from other areas and leave again when activity declines. However, of the in-migrants about one-half will make Santa Barbara County their permanent residence.

Ventura County population changes are projected to be major as a result of proposed Sale No. 48 associated activity and secondarily induced activity. During the peak production year of 1986 the population of the county is projected to increase by 17,577 persons, or 3.01 percent of the projected 1985 population of 584,100. During 1980, population increases are minor with a 849 increase or 0.17

percent. However, by 1985 the population is projected to increase by 11,951, or 2.05 percent. The maximum increase for one year is 1990 with an increase of 17,865. That is 2.69 percent above the projected 1990 population of 664,000. The rate and absolute population increases decline to 8,755, 1.18 percent, in 1995 and to 8,614, 1.06 percent, in the year 2000. In-migration will be responsible for a majority of the peak year population increases. Net migration is projected to be +849 in 1980, increasing to a peak of +10,887 in 1985, decreasing to +5,537 in 1986, a net of -161 in 1990, a large net of -9,457 in 1995 and leveling out to -303 in the year 2000. As these data indicate, much of the labor required for peak year activity will migrate into the county and leave when peak activity declines. One-third of the in-migrants, however, are expected to remain in the county permanently (Tables III.E.19-1, 2 and 3).

Throughout the life of proposed Sale No. 48, activity and secondarily induced activity, Ventura County is projected to absorb about one-half of the population increases of the five Southern California counties. The rate of population increase in Ventura County is about 7 to 17 times as great as for the area as a whole. In other words, Ventura County is projected to be impacted much more significantly than the other four Southern California counties. This can be explained by the fact that Ventura County is a major offshore staging area and pipelines are projected to come ashore in the county.

Population increases in Ventura County are projected to average 2.48 percent for the 1975-to-2000 period without proposed Sale No. 48. With proposed Sale No. 48 related activity and induced activity, this rate could be more than doubled during the peak years of activity, 1985 to 1990.

Baja California, Mexico population changes are projected to be insignificant as a result of proposed Sale No. 48. Since the population of San Diego County is projected to increase by only one-tenth of one percent or about 3,000 persons, it is unlikely that induced population changes in Baja California will ever approach that level. Increased tourism to Baja from the increased population in Southern California may result in an increase in labor demand in Baja with subsequent population increases.

Central California Coastal and Bay Area Counties population changes are projected to be insignificant for the life of the project. Alameda and Contra Costa Counties populations are projected to increase by 1,208 in 1986 for Alameda and 582 in 1990 for Contra Costa. The percentage increases are only one-tenth of one percent for each county during those peak years. Most of the other counties show minor population decreases or increases. None, however, show population changes above four-tenths of one percent.

Central California population changes indicate that some population declines in those counties may show up as population increases in Bay Area and Southern California Counties. Net migration in the central and Bay Area Counties are also projected to be minor (Tables III.E.14-1 and 2).

Table III.E.14-4 shows the peak year population changes projected for all the accumulative projects discussed in Chapter I with an LNG site at Point Conception, Santa Barbara County, California. Other LNG sites are discussed in POCS Reference Paper No. IV.

Table III.E.14-4

CUMULATIVE POPULATION CHANGES IN 1986

Area/County	Most Probable Proposed Sale No. 48	Existing Federal Leases	All Other Cumulative With LNG at Pt. Conception	Total
Los Angeles	9,946	3,303	10,945	24,204
Orange	248	136	7,994	8,378
San Diego	3,172	491	-574	3,089
Santa Barbara	3,498	6,398	35,185	45,081
Ventura	17,577	34,579	3,790	55,946
So. California	34,451	44,907	57,340	136,698
California	34,426	45,844	84,871	165,141

In conclusion, population changes as a result of proposed Sale No. 48 are minor for the 5-county Southern California area although the increases in Ventura and Santa Barbara Counties are significant.

15. Impact on the Economy: As a whole, the Southern California economy will be impacted to a minor degree by proposed OCS Sale No. 48 and related activity. This section discusses the impacts on employment, income, financial transactions of counties, taxable sales and public school enrollment as well as hospital facilities and police requirements.

a. Impact on Employment: The employment data presented in this section was derived from computer outputs using the Curtis Harris Economic Model. For more detailed information about the model and inputs and outputs, see POCS Reference Paper No. IV.

Southern California Employment, as a result of proposed Sale No. 48 and induced activity, is projected to increase by 685 in 1980, increasing to 12,438 by 1985, reaching a peak of 14,629 in 1986 before declining to 13,131 in 1990 and averaging about 8,500 from 1995 to 2000. (See Table III.E.15.a-1). Although the employment totals are high, in an absolute sense, they are minor compared to the total employment of 4.7 million in the Southern California counties in 1978. The percentage increase in any one year for the area is less than 0.3 percent.

Direct non-construction employment is shown in Table III.E.15.a-2 for each of the five Southern California counties. During the peak year of direct employment, in 1985, a total of 3,497 would be directly employed in OCS Sale No. 48 related activity.

Table III.E.15.a-3 shows the projected platform fabrication employment resulting from proposed OCS Sale No. 48-related platform fabrication. It is difficult to determine where this employment will take place. It will depend upon which shipyards are awarded contracts to construct platforms. However, the Harris Model outputs indicate that during 1985 California shipyards could employ 1054 new workers as a result of proposed OCS Sale No. 48 platform requirements. That is about 40-percent of the total platform fabrication employment for that year. This does not mean that all of the remaining platform fabrication employment will take place outside of California. It may be that some shipyards in California would continue at their current level of employment due to proposed Sale No. 48 platform fabrication requirements. The model outputs only indicate new jobs created as a result of the OCS activity.

Los Angeles County Employment is projected to increase by 5,063 during the peak year of activity in 1986. That is about a 0.15 percent increase over the 3.2 million employed in the county during 1977.

Table III.E.15.a-1

MOST PROBABLE EMPLOYMENT CHANGES
DUE TO PROPOSED OCS SALE NO. 48
INDUCED ACTIVITY, 1980 - 2000

County	Year											
	1980 %[a] Change		1985 % Change		1986 % Change		1990 % Change		1995 % Change		2000 % Change	
Los Angeles	162	z[b]	4,301	z	5,063	z	4,629	z	3,788	z	3,810	z
Orange	3	z	243	z	223	z	-4	z	-119	z	-206	z
San Diego	60	z	1,205	z	1,331	z	930	z	769	z	968	z
Santa Barbara	134	z	1,289	z	1,572	1.1	1,060	z	627	z	551	z
Ventura	326	z	5,400	2.9	6,440	3.4	6,516	3.2	4,105	1.9	3,036	13
Southern California Total	685	z	12,438	z	14,629	z	13,131	z	9,170	z	8,159	z
California Totals	725	z	12,472	z	14,546	z	12,694	z	8,706	z	7,395	z

[a] Percent change over projected level of employment for that year.
[b] z means less than 1 percent change.

Table III.E.15.a-2

PROPOSED SALE NO. 48
DIRECT NON-CONSTRUCTION
EMPLOYMENT - BASED ON MOST PROBABLE RESOURCE ESTIMATES

Year	Santa Barbara County	Ventura County	Los Angeles County	Orange County	San Diego County	Five County Total
1979	32	79	48	4	29	192
80	111	263	168	8	29	579
81	120	285	230	8	71	714
82	219	504	490	24	171	1,408
83	363	868	766	33	169	2,199
84	410	993	1,151	41	203	2,798
1985	565	1,167	1,512	75	178	3,497
86	445	1,073	1,107	42	309	2,976
87	414	855	875	38	146	2,328
88	222	534	572	25	108	1,461
89	148	355	396	19	95	1,013
1990	109	262	323	17	95	806
91	103	247	270	13	95	728
92	103	247	270	13	95	728
93	103	247	270	13	95	728
94	103	247	270	13	95	728
1995	103	247	270	13	95	728
96	103	247	270	13	95	728
97	103	247	270	13	95	728
98	103	247	270	13	95	728
99	103	247	270	13	95	728
2000	103	247	270	13	95	728

Table III.E.15.a-3

PROPOSED SALE NO. 48

PLATFORM FABRICATION EMPLOYMENT

	Platforms Placed		Platform Fabrication		
	Conventional (less than 1200')	Deep Water (over 1200')	Employment Conventional	Employment Deep	Total Employment
1979					
80					
81			460	387	847
82	4		1,150	1,160	2,310
83	6	1	1,265	2,320	3,585
84	5	2	805	2,707	3,512
1985	2	3	345	2,320	2,665
86	1	2	115	1,160	1,275
87		1		387	387

Note: Platform fabrication employment is based on 20% of platform cost with labor at $20,000 per Man Year.

[a]Conventional Platform, 230 Man Years (MY) over 24 months, 115 MY per year.

[b]Deep Water Platforms, 1160 Man Years over 36 months, 387 MY per year.

The most probable direct employment and components of that employment for Los Angeles County are shown in Table III.E.15.a-2 and 4. The data indicates that the major portion of direct employment will take place during 1984 to 1988. During those years, development well drilling and platform placement employment are at a peak. During 1985, as many as 904 persons could be employed in development well drilling operations and 308 in platform placement operations. Once these operations cease in 1991, direct employment levels out at 247 platform employees, including onshore mud suppliers and various other support activities; 6 offshore storage and treating plant employees and 17 onshore operations-base employees raise the total to 270 in the 1991-2000 period. As can be seen, once the development activity is over, operations and maintenance employment is very low.

Orange County Employment is projected to increase by 243 during the peak year of 1985. That is an insignificant increase compared to the 690,000 employed in the county during 1978 (Table III.E.15.a-1). The 243 increase includes both direct and indirect employment. The data indicates that during the 1990-2000 period when OCS activity declines, Orange County employment will actually be lower with proposed Sale No. 48 activity than without that activity. This can be explained by the fact that as jobs become available in Ventura and San Diego Counties, Orange County residents will move to those counties for employment, or will commute.

Direct proposed OCS Sale No. 48-related employment for Orange County is shown in Table III.E.15.a-2 and broken down into components in Table III.E.15.a-5. Peak direct employment is only 75 during 1985. Once OCS activity declines in the 1990-2000 period, direct OCS related employment drops to 13: 10 platform employees and 3 onshore operations-base employees.

San Diego County Employment is projected to increase by 1,331 during the peak year of 1986. This includes both direct and induced employment (See Table III.E.15.a-1 for direct and induced employment totals and Table III.E.15.a-2 for direct employment totals). Direct employment for 1986 in San Diego County is only 309 (see Table III.E.15.a-6). The induced employment totals for that year are projected as 108 for the finance, insurance and real estate industries, 193 for retail stores, 116 for medical and educational institutions, 106 for the construction industry, 171 for platform fabrication and 135 in State and local government. A detailed account of projected jobs by industry groupings in five-year intervals is available in POCS Reference Paper No. IV, Table III-28.

As the data indicates, the impact of proposed OCS Sale No. 48 related and induced employment will have a minor impact on employment in San Diego County in comparison to the 556,000 employed in 1978.

Table III.E.15.a-4

MOST PROBABLE DIRECT EMPLOYMENT - LOS ANGELES COUNTY

Year	Exploratory Well Drilling Employment	Development Well Drilling Employment	Platform Employment	Offshore Storage and Treating Employment	Operations Base Employment	Platform Placement Employment
1979	48					
80	146	22				
81	146	84				
82	142	195	38	6	17	92
83	94	440	79	6	17	130
84	48	686	154	6	17	240
1985	48	904	229	6	17	308
86	23	784	247	6	17	30
87		605	247	6	17	
88		302	247	6	17	
89		126	247	6	17	
1990		53	247	6	17	
91			247	6	17	
92			247	6	17	
93			247	6	17	
94			247	6	17	
1995			247	6	17	
96			247	6	17	
97			247	6	17	
98			247	6	17	
99			247	6	17	
2000			247	6	17	

Table III.E.15.a-5

MOST PROBABLE DIRECT EMPLOYMENT - ORANGE COUNTY

Year	Exploratory Well Drilling Employment	Development Well Drilling Employment	Platform Employment	Platform Placement Employment	Offshore Storage and Separation Facility Employment	Onshore Operations Base Employment
1979	4				None	
80	4	4				
81	4	4				
82	8	4	3	6		3
83	4	17	3	6		3
84	4	27	7			3
1985	4	35	10	23		3
86		29	10			3
87		25	10			3
88		12	10			3
89		6	10			3
1990		4	10			3
91			10			3
92			10			3
93			10			3
94			10			3
1995			10			3
96			10			3
97			10			3
98			10			3
99			10			3
2000			10			3

The percentage increase of peak direct and induced employment is only 0.24 percent of the 1978 level.

Table III.E.15.a-6 shows the components of direct employment that could result from proposed Sale No. 48. During the peak year of 1986, as many as 309 persons could be employed directly on OCS activity divided as follows: 64 development well drilling, 69 platform employment (this includes onshore mud suppliers and support employment), 150 platform placement employees, 6 offshore storage and separation facility employees and 20 onshore operations-base employees. This onshore operations base would use existing dockside facilities; no new facilities would be built.

Santa Barbara County Employment is projected to increase by 1,572 during the peak year of 1986 as a result of proposed OCS Sale No. 48 direct and induced employment. That is a 1.1-percent increase above the projected level of employment for the county in 1986(See Table III.E.15.a-1 and 2 for most probable direct and induced, and direct employment totals). The percentage increase in employment is less than 1 percent for all other years from 1980-2000. The following shows some of the industry groupings in which induced jobs are projected for 1986: Wholesale trade, 90; finance, insurance and real estate, 119; retail stores, 223; medical and educational institutions, 132; construction, 490; State and local government, 157. POCS Reference Paper No. IV, Table IV-31 gives a detailed breakdown of jobs by industry groupings in 5-year intervals from 1980-2000.

Direct proposed OCS Sale No. 48-related employment is projected to peak at 565 in 1985. Tables III.E.15.a-2 and 7 show the direct employment totals and components of those totals respectively. During 1985, exploratory well drilling employment is projected at 19 persons, development well drilling employment at 407, platform employment of 71, operations-base employment of 12 and platform placement employment of 56 are also projected. During the 1990 to 2000 period, when direct OCS employment levels out, only 103 persons are projected to be employed directly by proposed OCS Sale No. 48 activity.

The Harris Model data indicates that the secondary induced employment impacts are much more significant than the direct OCS employment. During the peak year of employment in 1986, there are 2.53 persons projected to be employed in addition to each person employed directly by OCS activity.

Ventura County Employment is projected to increase by 6,516 during the peak year of 1990 as a result of proposed OCS Sale No. 48-related direct and induced activity. That is a 3.2-percent increase over the projected level of employment for that year. During the peak

Table III.E.15.a-6

MOST PROBABLE DIRECT EMPLOYMENT - SAN DIEGO COUNTY

Year	Exploratory Well Drilling Employment	Development Well Drilling Employment	Platform Employment	Platform Placement Employment	Offshore Storage and Separation Facility Employment	Onshore Operations Base Employment
1979	29					
80	29					
81	58	13				
82	58	26	23	38	6	20
83	58	39	46		6	20
84	29	64	46	38	6	20
85	29	77	46		6	20
86		64	69	150	6	20
87		51	69		6	20
88		13	69		6	20
89			69		6	20
1990			69		6	20
91			69		6	20
92			69		6	20
93			69		6	20
94			69		6	20
1995			69		6	20
96			69		6	20
97			69		6	20
98			69		6	20
99			69		6	20
2000			69		6	20

Table III.E.15.a-7

MOST PROBABLE DIRECT EMPLOYMENT - SANTA BARBARA COUNTY

Year	Exploratory Well Drilling Employment	Development Well Drilling Employment	Platform Employment	Offshore Storage Facility Employment	Operations Base Employment	Platform Placement Employment
1979	28	4				
80	93	18				
81	93	27				
82	102	70	8		12	27
83	65	159	44		12	83
84	19	247	61		12	71
1985	19	407	71		12	56
86	10	297	79		12	47
87	9	257	86	5	12	
88		119	86	5	12	
89		45	86	5	12	
1990		6	86	5	12	
91			86	5	12	
92			86	5	12	
93			86	5	12	
94			86	5	12	
1995			86	5	12	
96			86	5	12	
97			86	5	12	
98			86	5	12	
99			86	5	12	
2000			86	5	12	

production year of 1986, employment is projected to increase by 6,440, or 3.4 percent, above the projected 1986 employment level (See Table III.E.15.a-1). The 1986 additional jobs of some industry groupings are as follows: Petroleum mining, 331; transportation, 498; wholesale trade, 338; finance, insurance and real estate, 886; motels, personal and repair services, 176; retail stores, 1,146; medical and educational institutions, 563; auto dealers and service, 220; construction, 1,293; eating, drinking places, 198; federal civilian, 193; State and local government, 651. Other industrial groupings show minor increases in employment (See Table III.E.15.a-8).

Direct employment resulting from proposed OCS Sale No. 48-related development activity is projected to peak in 1985 with 1,167. Tables III.E.15.a-2 and 9 show the year-by-year direct employment totals and components of those totals respectively. During 1985 a total of 45 persons are projected to be employed in exploratory well drilling activity, 782 in development well drilling, 173 on platforms (this total includes mud suppliers and some onshore support activities), 139 in platform placement and 28 in onshore operations bases. After OCS activity declines and levels out, in the 1991 to 2000 period, only 247 persons are projected to be directly employed in OCS activity.

Baja California Employment is projected to increase by an insignificant amount. Some additional jobs may be generated in Northern Baja due to increased tourism; the numbers, however, will be very small. San Diego County has a large tourism industry, but proposed Sale No. 48 activity only generates around 100 tourism-related jobs during the peak year of 1986. Baja can, therefore, expect to have increases of jobs for less than 100 persons.

Central Coastal and Bay Area Counties Employment is projected to be impacted by less than 1 percent per year for the life of the project. As Table III.E.15.a-1 indicates, almost all of the employment generated by proposed OCS Sale No. 48 will take place in the five Southern California counties. A few hundred persons may be employed in the Bay Area in platform fabrication and a few counties may show a slight decrease in employment due to the migration of people to the Bay Area and Southern California.

Cumulative Employment resulting from OCS Sale No. 35 and existing Santa Barbara Channel leases is shown in Table III.E.15.a-10 for the five Southern California counties and California. These employment totals are in addition to proposed OCS Sale No. 48-related employment.

Table III.E.15.a-8

VENTURA COUNTY JOB TOTALS BY INDUSTRY GROUPINGS, 1980-2000

INDUSTRY GROUPINGS	JOBS 1980	1985	1986	1990	1995	2000
AGRIC & FOOD(1,2,4,14-23)[a]	0	0	1	1	1	2
FORESTRY & FISHERY(3)	0	2	2	2	1	0
NONPETROL MINING(5-7,9,10)	0	0	0	0	0	0
PETROLEUM MINING(8)	0	340	331	247	247	247
APPAREL & TEXTILES(24-27)	0	0	0	0	0	0
LUMBER & WOOD PROD(28-33)	0	1	2	4	8	7
CHEM & PLASTICS(35-38,40)	0	1	1	3	4	5
PETROLEUM REFINING(39)	0	0	0	0	0	0
LEATHER,GLASS,STONE(41-44)	0	2	3	7	8	9
IRON & STEEL(45)	0	0	0	0	0	0
OTHER METALS(46-52)	0	0	0	0	-1	0
MACH & MISC MFG(13,53-70,72-74)	0	1	1	3	7	5
TRANSPORTATION(75)	5	429	498	356	195	139
COMMUNICATIONS(34,76,77)	1	51	54	84	51	30
ELEC & GAS UTILITY(78,79)	0	16	19	22	15	12
WATER UTILITY(80)	0	5	6	7	5	3
WHOLESALE TRADE(81)	9	283	338	358	221	163
FINANCE,INS,R.E.(82,83)	7	576	886	1172	675	481
HOTELS,PERSONAL & REPAIR SVC(84)	2	164	176	279	176	125
RET STORES(85,89-91,94,95,97-99)	18	943	1146	1425	843	602
MED & EDUC INST(88)	8	514	563	821	531	389
AUTO DLRS & SVC(86,92,93)	4	183	220	240	143	104
CONSTRUCTION(11,12)	265	1034	1293	306	186	136
AMUSEMENTS & RECREATION(87)	1	64	69	106	82	58
EATING,DRINKING PLACES(96)	6	168	198	202	121	87
SHIPS,TRAINS,TRAILERS,CYCLES(71)	0	8	6	21	25	27
FEDERAL CIVILIAN GOVT(100)	5	181	193	235	155	114
STATE & LOCAL GOVT(101)	11	603	651	829	560	424
ARMED FORCES(103)	0	0	0	0	0	0
DOMESTIC SERVICES(102)	1	63	67	79	49	33
TOTAL	341	5630	6724	6809	4308	3202

[a]Numbers indicate Harris Model groupings.

Table III.E.15.a-9

MOST PROBABLE DIRECT EMPLOYMENT - VENTURA COUNTY

Year	Exploratory Well Drilling Employment	Development Well Drilling Employment	Platform Employment	Platform Placement Employment	Offshore Storage and Separation Facility	Onshore Operations Base Employment
1979	65	9				
80	220	43				
81	220	65				
82	241	151	20	64		28
83	155	386	104	195		28
84	45	597	146	177		28
1985	45	782	173	139		28
86	25	717	192	111		28
87	20	483	208	105	11	28
88		287	208		11	28
89		108	208		11	28
1990		15	208		11	28
91			208		11	28
92			208		11	28
93			208		11	28
94			208		11	28
1995			208		11	28
96			208		11	28
97			208		11	28
98			208		11	28
99			208		11	28
2000			208		11	28

Table III.E.15.a-10

PROJECTED SOUTHERN CALIFORNIA CUMULATIVE EMPLOYMENT, 1986
(OCS Sale No. 35 and Existing Santa Barbara Channel Leases)

County	Number
Los Angeles	1,765
Orange	118
San Diego	234
Santa Barbara	2,749
Ventura	13,592
Southern California	18,458
California	18,689

In conclusion, the employment increases projected to result due to proposed OCS Sale No. 48 and induced effects are minor although localized impacts in Ventura County could be significant with a 3.4-percent increase in 1986.

b. Impact on Income: The income data presented in this section was derived from computer outputs using the Curtis Harris Economic Model. For more detailed information about the Model and inputs and outputs see POCS Reference Paper No. IV.

The impact of proposed OCS Sale No. 48, direct and indirect activity, during the peak of 1986 on Southern California Gross Regional Product (GRP) is projected at $519 million. That is less than a 1-percent increase over the projected GRP for the area in 1986. Table III.E.15.b-1 shows the GRP changes from 1980 to 2000 at 5-year intervals for the five Southern California Counties, California and the U.S. During none of these years is the Southern California GRP increased by 1 percent. The impact of proposed Sale No. 48, direct and indirect activity, on the economy of Southern California is positive, but minor. The same is true for California as a whole and the United States. However, the economic impact on some counties is quite different.

Los Angeles County GRP is projected to increase by $172 million during the peak year of 1986 before leveling out at + $99 million during the 1995-2000 period. In only 1-year is the increase less than 1 percent.

Orange County GRP is projected to increase by $3 million during the peak of 1986 before decreasing by $1 million in 1995, and decreasing by $3 million by the year 2000. The increase or decrease is insignificant during any one year.

San Diego County GRP is projected to increase by $26 million during the peak year of 1985. That is less than a 1-percent increase. By 1986, the increase is only $23 million, the 1990 increase is $17 million, the 1995 increase is $13 million, and $19 million in the year 2000. The increase in any 1 year is insignificant.

Santa Barbara County GRP is projected to increase by $30 million in the peak year of 1986. That is a 1.2-percent increase over the projected GRP in 1986 of $2,619 million. During the other years the increase in GRP is less than 1 percent.

Ventura County GRP is projected to increase by $291 million during the peak year of 1986. That is a 9.7-percent increase. During 1985, the increase is projected to be $221 million, up 7.5 percent; 1990 up $236, or 7.9 percent; 1995 $139 million, up 3.7 percent; in the year 2000 up $105 million for a 2.3-percent increase. The data indicates that proposed OCS Sale No. 48, direct and indirect activity, could have a major positive economic impact on the county.

Table III.E.15.b-1

MOST PROBABLE GROSS REGIONAL PRODUCT CHANGES
IN MILLIONS OF 1972 DOLLARS, 1980 - 2000

AREA	1980 Change	%	1985 Change	%	Year 1986 Change	%	1990 Change	%	1995 Change	%	2000 Change	%
Los Angeles County	7	Z[a]	138	Z	172	Z	136	Z	99	Z	99	Z
Orange County	+0	Z	3	Z	3	Z	-0	Z	-1	Z	-3	Z
San Diego County	2	Z	24	Z	23	Z	17	Z	13	Z	19	Z
Santa Barbara County	5	Z	23	Z	30	1.2	22	Z	13	Z	12	Z
Ventura County	11	Z	221	7.5	291	9.7	236	7.4	139	3.7	105	2.3
Southern California Total	25	Z	409	Z	519	Z	411	Z	263	Z	232	Z
California Total	25	Z	420	Z	528	Z	409	Z	261	Z	222	Z
U.S.A. Total	35	Z	392	Z	392	Z	130	Z	60	Z	40	Z

[a] Less than 1-percent change.

Baja California GRP is projected to increase by a minor amount due to possible increased tourism. The increase, however, would most probably not reach 1 percent.

Central Coastal and Bay Area GRP is projected to increase or decrease by an insignificant amount.

The direct wage income on the individual Southern California Counties and the Southern California area is shown in Table III.E.15.b-2. Direct wages paid in Los Angeles County are projected at $30.2 million for the peak year of 1985. After OCS activity has declined and leveled out, it is projected to be $5.4 million for the 1995-2000 period. The most probable total direct wages paid for the period 1979 to 2000 is $545 million.

No direct wage income is projected for Baja California. Direct wage income, as used in this section, means exploratory drilling, and development drilling wages, platform placement and operations wages, onshore operations base wages and offshore storage and treating wages. Other wages such as platform construction are included as indirect income.

Personal income changes due to proposed OCS Sale No. 48, direct and indirect activity, in Southern California is projected to increase by $241 million during the peak year of 1986. That is less than a 1-percent increase over the projected level of personal income for that year.

Table III.E.15.b-2

DIRECT WAGE INCOME IN MILLIONS OF DOLLARS

			Year			
County	1980	1985	1986	1990	1995	2000
Los Angeles	3.3	30.2	22.1	6.5	5.4	5.4
Orange	0.2	1.5	0.8	0.3	0.3	0.3
San Diego	0.6	3.6	6.2	1.9	1.9	1.9
Santa Barbara	2.2	11.3	8.9	2.2	2.1	2.1
Ventura	5.3	23.3	21.5	5.2	4.9	4.9
Southern California Totals	11.6	69.9	59.5	16.1	14.9	14.9

Table III.E.15.b-3 shows the most probable personal income changes for the individual five Southern California Counties, for Southern California as a whole, and for the State of California. Personal income changes for the State and the entire Southern California area are less than 1 percent in any one year. However, individual counties such as Ventura and Santa Barbara show significant personal income increases.

Los Angeles, Orange and San Diego County personal income changes are insignificant for the life of the project.

Santa Barbara County shows a 1.1-percent personal income increase ($25.8 million) during the peak year of 1986. That is a minor but significant increase.

Table III.E.15.b-3

MOST PROBABLE PERSONAL INCOME CHANGES IN
MILLIONS OF 1972 DOLLARS

AREA	1980 Change	%	1985 Change	%	1986 Change	%	1990 Change	%	1995 Change	%	2000 Change	%
Los Angeles County	2.9	Z[a]	71.1	Z	80.6	Z	75.2	Z	67.5	Z	73.9	Z
Orange County	0.1	Z	3.9	Z	3.3	Z	0.1	Z	1.7	Z	3.9	Z
San Diego County	1.0	Z	19.9	Z	22.9	Z	16.1	Z	14.9	Z	20.1	Z
Santa Barbara County	2.3	Z	21.5	Z	25.8	1.1	17.3	Z	11.6	Z	11.5	Z
Ventura County	5.7	Z	87.9	3.3	108.5	3.9	109.6	3.6	74.9	2.1	63.3	1.5
Southern California Total	12.0	Z	204.3	Z	241.1	Z	218.3	Z	167.2	Z	167.9	Z
California Total	13.0	Z	203.5	Z	240.0	Z	208.6	Z	160.7	Z	153.2	Z

[a]Less than 1-percent change.

Ventura County personal income is projected to increase $109.6 million, or 3.6 percent, during 1990. That is a significant increase. The percentage increase in 1986 is even larger with 3.9 percent and a $108.5 million increase. During most year the increase is more than 1 percent. Only in the start up years, from 1979 to 1980, is the increase less than 1 percent.

Per capita income changes as a result of proposed OCS Sale No. 48 direct and indirect activity are less than 1 percent in any county, Southern California, and the State of California. Baja California and the central coastal and Bay area counties per capita income are also projected to be impacted insignificantly. Table III.E.15.b-4 shows the Southern California projected per capita income changes.

Table III.E.15.b-4

MOST PROBABLE PER CAPITA INCOME CHANGES
(IN 1972 DOLLARS)

AREA	1980	Year 1985	1886	1990	1995	2000
Los Angeles County	0	2	1	0	0	0
Orange County	0	1	1	0	0	0
San Diego County	0	0	0	-5	-5	-6
Santa Barbara County	1	5	5	1	2	-1
Ventura County	3	42	16	3	31	4
Southern California Totals	0	2	0	-2	0	-1

Cumulative impacts resulting from the development of existing Santa Barbara Channel lease and OCS Sale No. 35 leases are shown in Tables III.E.15.c-5 and 6.

Table III.E.15.b-5

GROSS REGIONAL PRODUCT (GRP)
($000 1972) 1986
(Existing Leases)

County	GRP
Los Angeles	85,832
Orange	170
San Diego	2,729
Santa Barbara	55,958
Ventura	570,837
Southern California	715,526
California	747,080

Table III.E.15.b-6

PERSONAL INCOME ($000 1972) 1986
(Existing Leases)

County	GRP
Los Angeles	27,916
Orange	1,852
San Diego	3,823
Santa Barbara County	44,622
Ventura	220,964
Southern California	299,177
California	303,024

In conclusion, income changes are projected to be minor, less than 1 percent, in the Southern California area although the impacts in Ventura County are significant with a 3.7-percent increase in 1986.

c. Impact on State and Local Government Finances, Taxable Sales, Hospitals, School Enrollments and Police Requirements: State and local government expenditures are projected to increase by over $29 million during the peak production year of 1986 due to proposed OCS Sale No. 48 direct and induced activity. Peak State and local government expenditures, however, would occur in 1990 with an increase of about $37 million. Table III.E.15.c-1 shows the State and local government expenditures on a county basis and for the entire Southern California area. These expenditure figures are derived from Curtis Harris Economic Model computer runs conducted for proposed OCS Sale No. 48. The expenditures include State and local government expenditures for current items, employee compensation and the construction of highways, sewer and water systems, public residential, public industrial, public educational and public hospital construction.

Table III.E.15.c-1

MOST PROBABLE STATE AND LOCAL GOVERNMENT EXPENDITURES
AND EMPLOYEE COMPENSATION
($000 1972)

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	-23	6,230	9,627	12,328	10,975	11,948
Orange	-17	102	272	8	-270	-556
San Diego	72	2,451	2,796	2,677	2,241	3,183
Santa Barbara	76	2,340	3,252	3,239	1,988	1,863
Ventura	201	12,081	13,479	18,510	13,480	10,832
Southern California Totals	309	23,204	29,426	36,762	28,414	27,270

State and local government revenues are projected to reach a peak of about $18 million in 1986, coupled with expenditures of $29 million in 1986. A deficit of about $12 million would result in the five Southern California counties. This could result in increases of property or sales taxes of less than two-tenth of 1 percent (less than 0.002). State and local government expenditures would not be completely offset by increased revenues, but the deficit is insignificant compared to the revenues generated in the Southern California counties which amounted to

Table III.E.15.c-2

MOST PROBABLE STATE AND LOCAL GOVERNMENT REVENUES
($000 1972)

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	146	5,185	6,053	5,802	5,140	5,581
Orange	-6	212	236	16	-102	-235
San Diego	66	1,500	1,711	1,182	1,061	1,443
Santa Barbara	155	1,645	1,908	1,296	873	856
Ventura	391	6,468	7,875	8,048	5,611	4,663
Southern California Totals	752	15,010	17,783	16,344	12,583	12,308
(Deficit) or Surplus	443	(8,194)	(11,643)	(20,418)	(15,831)	(14,962)

Table III.E.15.c-3

MOST PROBABLE STATE AND LOCAL GOVERNMENT
DEFICIT (-) OR SURPLUS BY COUNTY, 1980-2000
($000 1972)

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	169	-1,045	-3,574	-6,526	-5,835	-6,367
Orange	11	110	-36	8	168	321
San Diego	-6	-951	-1,085	-1,495	-1,180	-1,740
Santa Barbara	79	-695	-1,344	-1,943	-1,115	-1,007
Ventura	190	-5,613	-5,604	-10,462	-7,869	-6,169
Southern California Totals	403	(-8,194)	(-11,643)	(-20,418)	(-15,831)	(-14,962)

$4,218 million in property taxes and $2,524 million in sales taxes in 1975 (see Table III.E.15.c-2). Table III.E.15.c-3 shows the most probable State and local government deficit or surplus by county at 5-year intervals from 1980-2000. The largest deficit is generated during 1990 with about $20 million. That would require a tax increase of 0.003 or three-tenths of one percent of sales and property taxes combined, based on the sales and property taxes generated in 1975. The taxes generated in 1990 would, of course, be much higher if the present tax laws were to continue and the rate increase smaller.

Los Angeles County State and local government is projected to have a surplus of $169,000 generated in 1980 as a result of proposed OCS Sale No. 48 direct and induced activity. Starting in 1985, a deficit of $1,045,000 would result, rising to a deficit of $6,526,000 in 1990, $5,835,000 in 1995 and $6,367,000 in the year 2000. The peak deficit of $6,526,000 in 1990 could result in a combined sales and property tax increase of two-tenths of one percent (0.002), based on the $4,197 million sales and property taxes generated in 1975 for Los Angeles County. The impact on Los Angeles County finances could be negative but insignificant due to proposed OCS Sale No. 48 even if the entire deficit were financed by property and sales taxes only (see Tables III.E.15.c-1, 2 and 3).

Orange County State and local government is projected to have a small surplus generated as a result of proposed OCS Sale No. 48 direct and induced activity. The surplus is projected to be $11,000 in 1980, rising to $110,000 in 1985, increasing to $168,000 in 1995 and $321,000 in the year 2000. The surplus, however, is minor compared to the taxes generated in Orange County due to property and sales taxes in 1975 which totaled $1,034 million. The reduction of sales and property taxes would only be 0.0003, or three-hundredths of one percent, during the peak surplus year (see Tables III.E.15.c.-1, 2 and 3).

San Diego County State and local government revenues minus expenditures are projected to show a deficit of $6,000 in 1980 due to proposed OCS Sale No. 48 direct and induced activity. By 1985, a deficit of $951,000 is projected, deficits of $1,085,000 in 1986, $1,495,000 in 1990, $1,180,000 in 1995 and a deficit of $1,740,000 in the year 2000. If the deficit of $1,740,000 in the year 2000 were financed by an increase in sales and property taxes, these taxes combined could increase by 0.21 percent based on the $843,000,000 of sales and property taxes generated in San Diego County in 1975. The sales and property taxes generated in San Diego County in the year 2000 would, of course, be much higher than in 1975 and the rate of tax increase necessar., to eliminate the deficit much smaller. The impact of proposed OCS Sale No. 48 on San Diego State and local government finances is projected to be negative but minor (see Tables III.E.15.c-1, 2 and 3).

Santa Barbara County State and local government revenues minus expenditures are projected to show a surplus of $79,000 in 1980 and deficits of $645,000 in 1985, $1,344,000 in 1986, $1,943,000 in 1990, $1,115,000 in 1995 and $1,007,000 in the year 2000. If the peak deficit of $1,943,000 in 1990 were financed by increases in sales and property taxes only, then these taxes could increase by 1.22 percent in 1990 based on the $159 million of sales and property taxes generated in Santa Barbara County in 1975. The tax base for both property and sales taxes would, of course, be much larger in 1990 than in 1975 and the tax increase necessary would, therefore, be much smaller. Also, a large portion of State government expenditures are paid for through the State income tax, which would result in a lessening of the local tax burden, also. The peak impact of proposed OCS Sale No. 48 direct and induced activity on State and local government finances in Santa Barbara County could be small. This is a small, but significant, increase (see Tables III.E. 15.c-1, 2 and 3).

Ventura County State and local government revenues minus expenditures are projected to show a surplus of $190,000 in 1980 and deficits of $5,613,000 in 1985, $5,604,000 in 1986, $10,462,000 in 1990, $7,879,000 in 1995 and $6,169,000 in the year 2000. If the peak deficit of $10,462,00(in 1990 were financed by increases of sales and property taxes only, the taxes could increase by 4.36 percent based on the $240 million of sales and property taxes generated in Ventura County in 1975. The tax base for both sales and property taxes would, of course, be much larger in 1990 than in 1975 and the rate of increase would, therefore, be smaller. Also, a large portion of State government expenditures could result in a lessening of the local tax burden. In conclusion, the impact of proposed OCS Sale No. 48 direct and induced activity on Ventura County State and local government finances is of major proportions, which could result in significant tax increases (see Table III.E.15.c-1, 2 and 3).

Central California Coastal and Bay area counties are projected to have insignificant financial impact due to proposed OCS Sale No. 48 and related activity.

Baja California is projected to have insignificant financial impact due to proposed OCS Sale No. 48.

Taxable sales in the five Southern California counties are projected to increase by $153 million during the peak year of 1986. That is a .36 percent increase over the $42,063 million taxable sales recorded in 1976. During all years from 1980 to 2000, taxable sales are projected to increase in the Southern California area. The increases are projected to be about $6 million in 1980, $128 million in 1985, $142 million in 1990, $109 million in 1995 and $107 million in the year 2000. Table III.E.15.c-4 shows the projected most-probable taxable sales changes from 1980 to 2000 for Southern California.

Table III.E.15.c-4

MOST PROBABLE TAXABLE SALES CHANGES
($000 1972)

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	1,021	43,952	52,244	49,536	44,189	48,303
Orange	-59	1,748	1,594	-6	-1,019	-2,327
San Diego	542	13,003	14,439	10,449	9,584	12,957
Santa Barbara	1,265	13,486	16,685	11,424	7,160	7,481
Ventura	3,183	55,469	68,255	70,453	48,350	40,714
Southern California Totals	5,952	127,658	153,217	141,856	108,714	107,128

Los Angeles County is projected to have a taxable sales increase of $52 million during the peak year of 1986. That is a .19 percent increase over the $27,415 million in taxable sales in 1976.

Orange County is projected to have a taxable sales decrease of $2 million during the year 2000. That is a .03 percent decrease from the 1976 taxable sales total of $6,966 million.

San Diego County is projected to have a maximum taxable sales increase of $14 million in 1986. That is a .26 percent increase over the 1976 taxable sales level of $5,396 million.

Santa Barbara County taxable sales are projected to increase by a maximum of $7 million in 1986. That is a 1.76 percent increase over the $968 million taxable sales in 1976.

Ventura County taxable sales are projected to increase by a maximum of $70 million in 1990. That is a 5.31 percent increase over the $1,319 million taxable sales in 1976. That is a major increase of taxable sales in Ventura County.

In conclusion, taxable sales are projected to increase or decrease insignificantly in Los Angeles, Orange and San Diego Counties. The increase in Santa Barbara County is moderate, while Ventura County is projected to have a major increase in taxable sales throughout the life of proposed OCS Sale No. 48-related activity.

Taxable sales in central coastal and Bay Area counties and Baja California are projected to increase or decrease insignificantly.

Hospital facilities in the five Southern California counties required due to proposed OCS Sale No. 48 direct and induced activity is projected to be 145 hospital beds during the peak year of 1986. That is a .25 percent increase over the 57,597 hospital beds available in 1976. Regionally, it would appear that presently available hospital facilities will be adequate to handle a .25 percent additional load. However, the 60 hospital beds required in Ventura County by 1986 represent a 3.95 percent increase over the 1,544 hospital beds available in Ventura County in 1976. It is projected, therefore, that additonal hospital facilities would have to be constructed in Ventura County. See Table III.E.15.c-5 for a county-by-county breakdown of hospital bed requirements.

Table III.E.15.c-5

MOST PROBABLE HOSPITAL BEDS REQUIRED BY COUNTY, 1980-2000[a]

County	Year					
	1980	1985	1986	1990	1995	2000
Los Angeles	2	46	56	55	44	44
Orange	-0	1	1	-0	-2	-5
San Diego	0	10	12	12	11	13
Santa Barbara	1	14	16	10	6	6
Ventura	3	41	60	61	30	29
Southern California Totals	6	112	145	138	89	87

[a]Based on population changes as indicated by Table III.E.14-1.

Most probable school enrollment changes in the five Southern California counties is shown in Table III.E.15.c-6. The average classroom in Southern California holds 30 students. This means that during the peak year of 1986, about 230 new classrooms could be required to educate the additional 6,890 pupils. This, however, is probably not going to be the case since school enrollment was down in several counties for the last two years (see Table II.G.2.d-7).

Table III.E.15.c-6

MOST PROBABLE SCHOOL ENROLLMENT CHANGES BY COUNTY, 1980-2000[a]

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	58	1,677	2,036	2,003	1,582	1,585
Orange	-2	54	51	-8	-56	-212
San Diego	28	562	634	644	608	706
Santa Barbara	65	589	700	451	254	257
Ventura	170	2,390	3,515	3,573	1,751	1,723
Southern California Totals	317	5,233	6,890	6,619	4,104	4,027
Central California Totals	-6	-68	73	122	-299	153
California Totals	309	4,905	6,885	5,692	4,186	4,116

[a]Based on 20% of population is of school age, grades K through 12.

Los Angeles County enrollment was down by 5,345 pupils in the fall of 1975. The projected enrollment increase for 1986 is only 2,036. It appears that no new schools or classrooms would be needed in Los Angeles County as a result of proposed OCS Sale No. 48 direct and induced activity (see Table III.E.15.c-6).

Orange County enrollment has been increasing at a .5 percent rate. Proposed Sale No. 48 activity could lead to requirements of two classrooms and two additional teachers in the county during the peak year of enrollment increase, 1985. In the 1990 to 2000 period, however, school enrollment is projected to decrease as a result of proposed OCS Sale No. 48 (see Table III.E.15.c-6).

San Diego County school enrollment is projected to increase by 644 during the peak enrollment year of 1990. This could require the building of a 21 classroom school and an additional 21 teachers would be needed to educate the students. San Diego County, unlike Los Angeles County, has had a rapid increase in school enrollment. The 1975 increase was 1 percent (see Tables II.G.2.d.-7 and III.E.15.c-6).

Santa Barbara County school enrollment is projected to increase by a maximum of 200 in 1986. That could require a new school with 7 classrooms and 7 new teachers to educate the new students. However, Santa Barbara County school enrollment has been down the last few years. The 1975 decrease was 794 students at 1.4 percent. It would appear that if the present trend were to continue, the new students resulting from proposed OCS Sale No. 48 related activity would merely offset the decline.

Ventura County school enrollment is projected to increase by 3,573 in 1990 as a result of proposed OCS Sale No. 48 and related activity. This could result in the requirement of one new high school of 37 classrooms with associated teachers and administrative personnel; and it could result in the need for 4 new elementary schools (K through 8) of 20 classrooms, each, with associated teachers and administrative personnel. Ventura County school enrollment has been increasing at a .5 percent rate and schools in the county are already overcrowded. Proposed OCS Sale No. 48 induced enrollment increases would worsen the problem considerably since the projected 1990 rise of enrollments is a 3.3 percent increase (see Tables II.G.2.d-7 and III.E.15.c-6). The cost of new schools and other facilities could be offset in part by the Federal CEIP funds.

Central Coastal and Bay Area County as well as Baja California school enrollment changes are projected to be insignificant as a result of proposed Sale No. 48.

Police employee requirements in Southern California as a result of proposed OCS Sale No. 48 are shown in Table III.E.15.c-7. The figures are based on the assumption that each county would want to continue the existing police employee-to-population ratios in the future. The additional police required are insignificant in all counties except Ventura County, which shows a need for an additional 39 police employees by 1990 (see POCS Reference Paper No. II for current police employment, Section II.G.2.d). Additional police employee requirements in central coastal and Bay Area counties as well as Baja California are insignificant as a result of proposed OCS Sale No. 48.

Cumulative impacts during the peak year of activity in 1986 resulting from Sale No. 35 and existing Santa Barbara Channel leases are presented in Tables III.E.15.c-8 through 12.

d. Capital Investment: The most probable capital investment is shown in Table III.E.15.d-1. The majority of the capital investment required for proposed OCS Sale No. 48 will be for the 31 platforms needed to develop the proposed 217 tracts. Over $1.5 billion will be required for platform investment due to the high cost of deepwater platforms. These platforms could cost as much as $117 million each, with 9 being required for development. Conventional platforms, for water depths of less than 1,200 feet, could cost from $26 million to $41

Table III.E.15.c-7

MOST PROBABLE POLICE EMPLOYEE REQUIREMENTS[a] BY COUNTY, 1980-2000

County	Year 1980	1985	1986	1990	1995	2000
Los Angeles	1	26	32	31	24	25
Orange	0	1	0	-0	-1	-2
San Diego	0	6	6	6	6	7
Santa Barbara	1	7	9	6	3	3
Ventura	2	26	38	39	19	19
Southern California Totals	4	66	85	82	51	52

[a]Based on the police employee to population ratios in 1974 for each county: Los Angeles County, 1 police per 316 of population; Orange County, 1 police per 520 of population; San Diego County, 1 police per 501 of population; Santa Barbara County, 1 police per 408 of population; Ventura County, 1 police per 463 of population.

million each. Each platform would have pollution control equipment such as booms and dispersants. The total for platform pollution control investment could be over $1,200,000.

The projected 86 exploratory wells, 32 wells averaging 11,000 feet in depth costing $2,500,000 each, and 54 wells averaging 6,000 feet in depth costing $2,500,000, could total $247,000,000. Development wells, 701 wells averaging 5,000 feet at $750,000 each, could cost as much as $525,750,000. The 71 subsea completions projected could require a capital investment of $177,500,000. These subsea completion wells and equipment could average $2.5 million.

Offshore pipeline investment could range from a low of $420,000 per mile for some gas lines to a high of $900,000 per mile for a 16-inch oil line from the Tanner-Cortes Banks area to Ventura County. Total pipeline investment could reach $274,560,000, while offshore storage and treating facilities could require a capital investment of $60,140,000. Finally, the projected onshore operations bases, two in the Santa Barbara Channel area and two in the San Pedro-Long Beach area, are expected to cost $3 million each, for a total of $12 million.

Table III.E.15.c-8

STATE AND LOCAL GOVERNMENT FINANCES ($000 1972) 1986
EXISTING FEDERAL LEASES

County	Revenues	Expenditures	Surplus or (-) Deficit
Los Angeles	2,680	2,991	-311
Orange	79	75	4
San Diego	319	580	-261
Santa Barbara	4,351	6,747	-2,396
Ventura	21,926	30,998	-9,072
Southern California	29,355	41,391	-12,036
California	29,359	40,472	-11,113

Table III.E.15.c-9

TAXABLE SALES ($000 1972) 1986
EXISTING FEDERAL LEASES

County	Taxable Sales
Los Angeles	16,735
Orange	590
San Diego	2,990
Santa Barbara	29,066
Ventura	141,111
Southern California	190,492
California	188,370

Table III.E.15.c-10

NEW SCHOOL ENROLLMENT, 1986
EXISTING FEDERAL LEASES

County	No. of New Students	No. of Classrooms
Los Angeles	661	22
Orange	27	1
San Diego	98	3
Santa Barbara	1,280	43
Ventura	6,916	231
Southern California	8,982	300
California	9,169	306

Table III.E.15.c-11

NEW POLICE EMPLOYEES REQUIRED, 1986
EXISTING FEDERAL LEASES

County	No. of Police Employees
Los Angeles	11
Orange	0
San Diego	1
Santa Barbara	16
Ventura	86
Southern California	114
California	115

Table III.E.15.c-12

NEW HOSPITAL BEDS REQUIRED, 1986
EXISTING FEDERAL LEASES

County	No. of Hospital Beds
Los Angeles	13
Orange	1
San Diego	2
Santa Barbara	26
Ventura	138
Southern California	180
California	207

Table III.E.15.d-1

MOST PROBABLE CAPITAL INVESTMENT
1979-2000

Exploratory Well Investment	
32 wells averaging 11,000' in depth at $3,500,000	$ 112,000,000
54 wells averaging 6,000' in depth at $2,500,000	135,000,000
Total	$ 247,000,000
Development Well Investment	
701 wells averaging 5,000' in depth at $750,000	$ 525,750,000
Platform and Equipment Investment	1,505,901,000
Pollution Control Investment	1,200,000
Subsea Completion Investment	177,500,000
Offshore Pipeline Investment	274,560,000
Offshore Storage and Treating Investment	60,140,000
Onshore Operations Base Investment	12,000,000
Total Investment	$2,804,051,000

F. Alternative Development Scenarios' Impacts

1. Maximum Resource Estimates: The U.S. Geological Survey estimated the maximum undiscovered recoverable resource potential for the entire proposed Sale No. 48 area to be 2,332,740,000 barrels of oil and 1,968,900,000,000 cubic feet of gas. The probability is low, only 5 percent, that this amount of resource potential exists in the proposed sale area.

Table III.F.1-1 shows the development activity that could occur if the maximum resource potential were discovered. A total of 135 exploratory and 1,625 development wells could be drilled and 56 platforms placed. In addition 286 subsea completions and 469 kilometers (756 miles) of pipeline may be required. It is also estimated that 5 Offshore Storage and Treating Facilities could be required. The transportation scenario would remain the same as described for the most probable estimates.

If the maximum resource potential were discovered and developed, the expected number of oil spills of 1,000 barrels or more could be 14. Table III.F.1-2 shows an area by area breakdown of the expected number of spills of 1,000 barrels or more for the 1979 to year 2000 period based on 1.8 spills for each billion barrels handled by platforms, 2.3 spills for each billion barrels of oil pipelined and 3.87 spills for each billion barrels of oil tankered or barged.

The expected number of spills between 50 and 1,000 barrels for the entire sale area could be 36, based on one spill of 50 to 1,000 barrels for each 65,000,000 barrels of OCS production. For the 21 year study period (1979-2000) this could mean 2 small spills of 50 to 1,000 barrels every year and a large spill of 1,000 barrels or greater every year and a half.

a. Impacts: The biological impact of the maximum resource potential lease and development could be heavy on marine birds and mammals. The Channel Islands are the major haulout and rookery areas for pinnipeds in California. San Miguel Island and Anacapa Island are sites of endangered mammals and birds (see Section III.C.1.f.). The impacts of several successive oil spills and associated cleanup operations could pose a threat to these endangered species locally, but not to the continued existence of these species throughout their entire range.

The impacts on air quality from maximum resource development would be similar to those given for expected development in Section III.D.1. Increases in impacts are expected to be proportional to increases in emissions. Table III.F.1-3 presents an estimate of the emissions in each area.

Table III.F.1-1

MAXIMUM RESOURCE ESTIMATES (5 PERCENT PROBABILITY OF OCCURRENCE)

Area	Exploratory Wells Drilled	Development Wells Drilled	Platforms	Subsea Completions	Miles of Pipeline Laid	Offshore Storage & Treating Facilities	Drill Cuttings BBL's	Oil Produced Peak/Year M BBL's (1986)	Gas Produced Peak/Year MMCF (1986)	Formation Water (1986) M BBL/ Year	Mud to Be Dumped BBL Total	Platform Sewage (1986) Gallons Per Day
Santa Barbara Channel	64	816	21	140	294	3 (200,000 B/d)	1,124,604	149,889 (1,181,400)	149,889 (997,100)	31,160 (245,596)	525,683	42,000
Santa Rosa	6	39	3	4	68		57,508	7,641 (60,000)	11,462 (50,600)	1,594 (12,518)	26,882	6,000
Santa Barbara Island	6	15	1	5	0	1 (25,000	26,837	2,351 (17,500)	1,881 (14,800)	480 (3,575)	12,545	2,000
Tanner-Cortes	31	553	19	95	300	0	746,328	103,746 (824,300	155,619 (695,800)	21,532 (171,081)	348,862	38,000
San Pedro	15	125	6	18	64	0	159,745	18,810 (150,000)	15,048 (126,600)	3,904 (31,132)	83,631	12,000
San Diego	13	77	6	24	30	1 (150,000 B/d)	115,016	12,638 (99,540)	18,957 (84,000)	2,623 (20,659)	53,763	12,000
TOTAL	135	1,625	56	286	756	5	2,249,207	293,900 (2,332,740)	351,800 (1,968,900)	60,998	1,051,366	112,000

M = 1,000

(Indicates 1979-2000 Totals)

Table III.F.1-2

EXPECTED NUMBER OF OIL SPILLS OF
1,000 BARRELS OR MORE WITH MAXIMUM
RESOURCE ESTIMATES (5 PERCENT PROBABILITY OCCURRENCE)

	Type of Spill			
Area	Platform	Pipeline	Tanker	Total
Santa Barbara Channel	2.13	1.36	5.25	8.74
Santa Rosa	.11	.14	0	.25
Santa Barbara Island	.03	0	.07	.10
Tanner-Cortes	1.48	.95	1.59	4.02
San Pedro	.27	.35	.07	.69
Dan Point-San Diego	.18	0	.39	.57
Total	4.20	2.80	7.37	14.37

Commercial fishing could be disrupted, especially in the Santa Barbara Channel area. The increased number of platforms would reduce the area available for commercial fishing to a significant level.

The esthetic impact in the Santa Barbara Channel Area could be major with 21 platforms projected for the maximum resource development. The impact could be especially severe in the vicinity of the Channel Islands National Monument. An unobstructed view is extremely desirable for National Parks and Monuments (see Section III.E.12).

The impact on the Southern California economy could be significant if the maximum resource potential were discovered and developed. It is projected that during the peak employment year of 1985 as many as 6,000 persons could be directly employed in OCS Sale No. 48 related activity. This could result in more than $118 million of income generated from direct OCS employment during 1985. A large portion of this employment could occur in the counties of Santa Barbara and Ventura. The impact on those counties is major with

Table III.F.1-3

EMISSIONS FROM MAXIMUM RESOURCE ESTIMATE FOR SALE NO. 48 SOURCES (NORMAL TANKERING)

Kg/hr

Area	THC	NO_x	CO	SO_2	TSP
Santa Barbara					
SBM	845	177	0.4	76	4.4
Platform	200	1092	247	94	100
Total	1045	1269	247	170	104
Ventura	3679	3366	0	205	3.7
Los Angeles					
Onshore	185	173	2.5	9.4	0.9
Offshore	28	171	41	14	15
Total	213	344	44	23	16
San Diego/Dana Point					
SBM	194	28	0.02	0.06	0.03
Platform	202	428	60	29	21
Total	396	456	60	29	21
Other Platform*	341	1173	234	84	91
GRAND TOTAL	5670	6610	585	511	236

* Near Santa Rosa Island, Santa Barbara Island and Tanner/Cortes Banks.

the most probable resource estimates and is projected to be extreme with the maximum resource potential. The demand for services placed on local government could require large capital outlays for schools, hospitals, police, fire stations, water and sewage facilities. (See POCS Reference Paper No. IV for more details.)

With the maximum resource estimates a gas processing plant could become economically feasible in San Diego County and another gas processing plant would be needed in Santa Barbara County. Both these plants would add to the existing air quality problems.

2. Minimum Resource: The level of impacts resulting from proposed Sale No. 48 is dependent primarily upon the amount of oil and gas found. The relationship between the level impacts and the amount of oil and gas is not 1:1; that is, finding only half the expected quantities of oil and gas will not reduce the potential impacts by 50 percent. It will, however, reduce them very substantially. Table III.F.2-1 shows the minimum resource potential for each area and the expected number of structures, pipelines and other development that are expected to result. Table III.F.2-2 shows the expected number of spills. Compare this to Tables III.A-1 through III.A-6 in Section III.A. In the Tanner-Cortes Bank area, for example, the most likely amount of oil to be produced is 280,000,000 bbl with 19 exploratory wells, 279 development wells and an expected 1.14 oil spills of 1,000 bbl or more. Assuming minimum resources, only 9,100,000 bbl will be produced, a 96.6 percent reduction. Note, though, that the reduction in exploratory wells, development wells and oil spills would be to 15, 78 and 0.06 or percentage reductions of 21.1, 72.1 and 94.7.

A comparison of the values for the other lease areas shows the same trend: slight reductions on the exploratory drilling effort, substantial reductions in development drilling and oil spills.

The expected number of oil spills, for all the proposed lease areas combined, will be reduced approximately 88 percent. Most oil spill impacts will be reduced to minor or negligible significance. Impacts from most other OCS activities will be reduced in a like manner. The area with the smallest reduction in expected oil spills, assuming minimum reserves, is the San Pedro area where a reduction of only 38 percent is expected.

In summary, all the impacts described in Section III will be substantially reduced except for those contributed by the San Pedro lease area. In this case, a moderate reduction, about one-third, can be expected.

Table III.F.2-1

MINIMUM RESOURCE ESTIMATES (95 PERCENT PROBABILITY OF OCCURRENCE)

Area	Exploratory Wells Drilled	Development Wells Drilled	Platforms	Subsea Completions	Miles of Pipeline Laid	Offshore Storage & Treating Facilities	Drill Cuttings BBL's	Oil Produced Peak/Year M BBL's (1986)	Gas Produced Peak/Year MMCF (1986)	Formation Water (1986) M BBL/ Year	Mud to Be Dumped BBL Total	Platform Sewage (1986) Gallons Per Day
Santa Barbara Channel	32	154	6	4	88	0	237,700	3,769 (31,100)	3,769 (27,500)	794 (6,553)	111,110	12,000
Santa Rosa	2	9	1	0	0	1 (1,000 B/d)	14,058	74 (600)	111 (600)	16 (126)	6,571	2,000
Santa Barbara Island	1	10	1	0	0	1 (1,000 B/d)	14,058	11 (77)	9 (70)	2 (16)	6,571	2,000
Tanner-Cortes	15	78	6	0	0	2 (7,000 B/d)	118,850	1,102 (9,100)	1,653 (9,000)	232 (1,918)	55,555	12,000
San Pedro	11	57	3	3	64	0	86,901	725 (6,000)	580 (5,700)	153 (1,264)	40,621	6,000
San Diego	7	36	1	0	0	1 (1,000 B/d)	54,952	34 (293)	51 (290)	7 (62)	25.687	2,000
TOTAL	68	344	18	7	152	5	526,519	5,710 (47,170)	6,180 (43,160)	1,203 (9,939)	246,115	36,000

M = 1,000

(Indicates 1979-2000 Totals)

Table III.F.2-2

EXPECTED NUMBER OF OIL SPILLS OF 1,000 BARRELS OR MORE WITH MINIMUM RESOURCE ESTIMATES

Area	Type of Spill			Total
	Platform	Pipeline	Tanker	
Santa Barbara Channel	0.06	0.07	0.12	0.25
Santa Rosa	0.00	0.00	0.00	0.00
Santa Barbara Island	0.00	0.00	0.00	0.00
Tanner-Cortes	0.02	0.00	0.04	0.06
San Pedro	0.11	0.14	0.04	0.29
Dana Point San Diego	0.00	0.00	0.00	0.00
Total	0.19	0.21	0.20	0.60

3. One Hundred Percent Tankering of Oil, Reinjection of Gas, Using Most Probable and Low Reserve Estimates: With this alternative no pipelines other than gathering lines, would be needed. This would create changes in the transportation proposed for three areas of this proposal. Without this alternative, all the volume from proposed tracts in San Pedro Bay and Santa Rosa Island areas will be pipelined to shore and 50 percent of the oil from the Santa Barbara Channel. The general result will be an increase in the probability of a spill greater than 1,000 bbls for those three areas and tanker routes associated with them and a decrease in the probability of an extremely large spill occurring. Data concerning this alternative are presented in Table III.F.3-1.

Based on past experience, the loss from pipelines is 0.37 percent of the loss from all sources associated with tankering.

For the most probable case, the following effects may occur by area:

Santa Barbara Channel; "Mixed A" transportation -

	2,250	bbl spilled from pipelines
	1,203,360	bbl spilled from tankers
Total =	1,205,610	bbl

San Pedro Bay; "Mixed A" transportation -

Total =	1,200	bbl spilled from pipelines
		No tankering
		"100-percent tankering" -
Total =	320,896	bbl

Santa Rosa Island; "Mixed A" transportation -

	225	bbl spilled from pipelines
	60,168	bbl spilled from tankers
Total =	50,393	bbl
		"100-percent tankering" -
Total =	60,168	bbl

All together, the "Mixed A" scenario would spill 1,267,203 bbl of oil over the lifetime of the proposal while the 100-percent tankering scenario would spill 1,584,424 bbl.

The number of spills greater than 1,000 bbl rises from 2.3 per billion barrels for pipelines to 3.87 per billion barrels for tankers. For this proposal, the expected number of spills is 4.1 and the probability of at least one spill is virtually certain at 0.98.

For a 3-day spill trajectory, only Segment 49 at 19-percent risk is significantly hazarded. With the 60-day trajectory several additional segments are hazarded as shown in Table III.F.3-1a which also compares the impact potential between the two scenarios.

Table III.F.3-1

MINIMUM RESOURCE ESTIMATES (100 PERCENT TANKERING OF OIL, REINJECTION OF EXCESS GAS)

Area	Exploratory Wells Drilled	Development Wells Drilled	Platforms	Subsea Completions	Miles of Pipeline Laid	Offshore Storage & Treating Facilities	Drill Cuttings BBL's	Oil Produced Peak/Year M BBL's (1986)	Gas Produced Peak/Year MMCF (1986)	Formation Water (1986) M BBL/ Year	Mud to Be Dumped BBL Total	LNG Lique- faction Facility	Platform Sewage (1986) Gallons Per Day
Santa Barbara Channel	32	154	6	4	None	0	237,700	3,769 (31,100)	3,769 (27,500)	794 (6,553)	111,110	None	12,000
Santa Rosa	2	9	1	0	0	0 (at 1,000 B/d)	14,058	74 (600)	111 (600)	16 (126)	6,571		2,000
Santa Barbara Island	1	10	1	0	0	1 (at 1,000 B/d)	14,058	11 (77)	9 (70)	2 (16)	6,571		2,000
Tanner-Cortes	15	78	6	0	0	2 (at 7,000 B/d)	118,850	1,102 (9,100)	1,653 (9,000)	232 (1,918)	55,555		12,000
San Pedro	11	57	3	3	0	0	86,901	725 (6,000)	580 (5,700)	153 (1,264)	40,621		6,000
San Diego	7	36	1	0	0	1 (at 1,000 B/d)	54,952	34 (293)	51 (290)	7 (62)	25,687		2,000
TOTAL	68	344	18	7	0	5	526,519	5,710 (47,170)	6,180 (43,160)	1,203 (9,939)	246,115		36,000

M = 1,000

Indicates 1979-2000 Totals)

Table III.F.3-1a

PERCENT CHANCE OF ONE OR MORE SPILLS GREATER THAN 1000 BARRELS OCCURRING AND CONTACTING LAND SEGMENTS OVER THE PRODUCTION LIFE OF THE LEASE AREA

Segment	100% Tankering (60-day)	Mixed A (60-day)
26	11 percent	22 percent
27	15 "	31 "
28	7 "	15 "
47	11 "	14 "
48	14 "	19 "
49	33 "	53 "
50	11 "	23 "
51	6 "	12 "
53	26 "	22 "
54	22 "	16 "

For minimum resource estimates (Table III.F.3-1), the following effects may occur by area:

Santa Barbara Channel; "Mixed A" Transportation -
233 bbl spilled from pipelines
124,748 bbl spilled from tankers
Total = 124,981 bbl
100-percent Tankering -
Total = 124,748 bbl

San Pedro Bay; "Mixed A" Transportation -
Total = 90 bbl spilled from pipelines
100-percent Tankering
Total = 24,067 bbl

Santa Rosa Island; "Mixed A" Transportation -
9 bbl spilled from pipelines
2,407 bbl spilled from tankers
Total = 2,416 bbl
100-percent Tankering
Total = 2,407 bbl

All together, the "Mixed A" scenario would spill 127,487 bbl of oil over the lifetime of the proposal while the 100-percent tankering scenario would spill 151,222 bbl.

The following estimated quantities of sediment will not be disturbed by pipeline construction by implementing this alternative.

	Miles of Pipeline
Santa Barbara Channel	16.9 km (10 miles) 4.1 x $10^4 m^3$ (5.36 x 10^4 yd^3)
Santa Rosa Island	16.9 km (10 miles) 4.1 x $10^4 m^3$ (5.36 x 10^4 yd^3)
San Pedro Bay	21.1 km (12.5 miles) 3.7 x $10^4 m^3$ (4.84 x 10^4 yd^3)

For most shoreline segments, based upon the spill model, the chance of a spill occurring and contacting the segment appears to be lower for 100-percent tankering than for the Mixed A scenario. The only ones for which a lower impact due to pipelines is predicted are Segments 53 and 54 (Catalina and San Clemente Islands). The impact potential on the Northern Channel Islands also appears to be lower for the 100 percent tankering scenario. Table III.F.3-2 lists the important resources in each segment affected by comparing the two scenarios.

Table III.F.3-2

IMPORTANT RESOURCES OF SOUTHERN CALIFORNIA

Segment 26 (Palos Verdes to Marina Del Rey)

Impact Risk

100% Tankering	11%
Mixed A	22%

Resources:
- Marine Life Refuge
- Sensitive Biological Area
- Rare and Endangered Species
- Kelp Beds
- Rocky Intertidal
- Sport Fishing
- High Intensity Use Beaches
- Skin and Scuba Diving
- Oceanarium
- Marinas
- Recreational Boating
- Historic Sites

Segment 27 (Santa Monica to Zuma)

Impact Risk

100% Tankering	15%
Mixed A	31%

Resources:
- ASBS
- Kelp Beds
- Rocky Intertidal
- Sport Fishing
- Clam Beaches
- High Intensity Use Beaches
- Skin and Scuba Diving
- Marinas
- Recreational Boating
- National Register Sites

Table III.F.3-2 (Cont.)

Segment 28 (Ventura County)

Impact Risk

100% Tankering	7%
Mixed A	15%

Resources:
- ASBS
- Sensitive Biological Areas
- Rare and Endangered Species
- Kelp Beds
- Sport Fishing
- High Intensity Use Beaches
- Skin and Scuba Diving
- Recreational Boating
- Cultural Resources

Segment 47 (San Miguel Island)

Impact Risk

100% Tankering	11%
Mixed A	14%

Resources:
- ASBS
- Rare and Endangered Species
- Sea Bird Breeding and Nesting
- Pinnipeds
- Kelp
- Rocky Intertidal
- Sport Fishing
- Skin and Scuba Diving

Segment 48 (Santa Rosa Island)

Impact Risk

100% Tankering	14%
Mixed A	19%

Resources:
- ASBS
- Rare and Endangered Species
- Sea Bird Nesting and Breeding
- Pinnipeds
- Kelp

Rocky Intertidal
Sport Fishing
Skin and Scuba Diving
Recreational Boating

Segment 49 (Santa Cruz Island)

Impact Risk

100% Tankering	33%
Mixed A	53%

Resources:
ASBS
Rare and Endangered Species
Sea Bird Breeding and Nesting
Pinnipeds
Kelp
Rocky Intertidal
Sport Fishing
Skin and Scuba Diving
Recreational Boating

Segment 50 (Anacapa Island)

Impact Risk

100% Tankering	11%
Mixed A	23%

Resources:
ASBS
Rare and Endangered Species
Sea Bird Breeding and Nesting
Pinnipeds
Kelp
Rocky Intertidal
Sport Fishing
Skin and Scuba Diving
Recreational Boating

Segment 51 (San Nicolas Island)

Impact Risk

100% Tankering	8%
Mixed A	12%

Table III.F.3-2 (Cont.)

Resources:
- ASBS
- Rare and Endangered Species
- Sea Bird Breeding and Nesting
- Pinnipeds
- Kelp
- Rocky Intertidal
- Sport Fishing

Segment 53 (Santa Catalina Island)

Impact Risk

100% Tankering	26%
Mixed A	22%

Resources:
- ASBS
- Ecological Reserves
- Rare and Endangered Species
- Sea Bird Breeding and Nesting
- Pinnipeds
- Kelp
- Rocky Intertidal
- Sport Fishing
- Skin and Scuba Diving
- Marinas
- Oceanarium

Segment 54 (San Clemente Island)

Impact Risk

100% Tankering	22%
Mixed A	16%

Resources:
- ASBS
- Rare and Endangered Species
- Sea Bird Nesting and Breeding
- Pinnipeds
- Kelp
- Rocky Intertidal
- Sport Fishing

---

4. 100-Percent Tankering Of Oil, LNG For Gas Within High Resource Estimates: By tankering 100 percent of the oil from the proposed Sale No. 48 rather than pipelining most of it, the same change in impact will be reflected as discussed in Section III.F.3 above, except for the two LNG liquification facilities that would be used in place of re-injecting the larger reserves of natural gas. As indicated in Table III.F.4-1, the high estimated natural gas within the Santa Barbara Channel and at the Tanner-Cortes Banks would warrant installation of an LNG liquification facility. Each of these facilities could process up to 200 million cubic feet of natural gas per day that can then be transported to a receiving facility.

Table III.F.4-1

MAXIMUM RESOURCE ESTIMATES(100 PERCENT TANKERING OF OIL,LNG FOR GAS)

Area	Exploratory Wells Drilled	Development Wells Drilled	Platforms	Subsea Completions	Miles of Pipeline Laid	Offshore Storage & Treating Facilities	Drill Cuttings BBL's	Oil Produced Peak/Year M BBL's (1986)	Gas Produced Peak/Year MMCF (1986)	Formation Water (1986) M BBL/ Year	Mud to Be Dumped BBL Total	LNG Lique- faction Facility	Platform Sewage (1986) Gallons Per Day
Santa Barbara Channel	64	816	21	140	None	4 (of 300,000 B/d)	1,124,604	149,889 (1,181,400)	149,889 (997,100)	31,160 (245,596)	525,683	1 at 200 MMCF	42,000
Santa Rosa	6	39	3	4		1 (at 100,000 B/d)	57,508	7,641 (60,000)	11,462 (50,600)	1,594 (12,518)	26,882		6,000
Santa Barbara Island	6	15	1	5		1 (at 25,000 B/d)	26,837	2,351 (17,500)	1,881 (14,800)	480 (3,575)	12,545		2,000
Tanner-Cortes	31	553	19	95		4 (at 250,000 B/d)	746,328	103,746 (824,300)	155,619 (695,800)	21,532 (171,081)	348,862	1 at 200 MMCF	38,000
San Pedro	15	125	6	18		1 (at 250,000 B/d)	159,745	18,810 (150,000)	15,048 (126,600)	3,904 (31,132)	83,631		12,000
San Diego	13	77	6	24		1 (at 150,000 B/d)	115,016	12,638 (99,540)	18,957 (84,000)	2,623 (20,659)	53,763		12,000
TOTAL	135	1,625	56	286		12	2,249,207	293,900 (2,332,740)	351,800 (1,968,900)	60,998	1,051,366		112,000

(Indicates 1979-2000 Totals)

M = 1,000

5. Onshore Pipeline from Ventura to Los Angeles

a. Foregone Development and Foregone Impact Sources: According to the most probable transportation scenario for Sale No. 48, all the oil production from the Tanner-Cortes Banks and Santa Rosa tracts, and 50 percent from the Santa Barbara Channel tracts would be transported by pipelines to the Ventura area. From the Ventura area 30 percent would be transported by tankers to San Francisco Bay, and 70 percent by barges to the Los Angeles area (POCS Reference Paper No. V). The remaining 50 percent of Santa Barbara Channel production would be piped by gathering lines to an offshore storage and loading facility and tankered and barged by the same transportation mix: 30 percent by tankers to San Francisco Bay and 70 percent by barges to Los Angeles.

Santa Barbara County as coordinator of the Industry/Government Pipeline Working Group has estimated that a new onshore pipeline from Ventura to the Los Angeles basin along U.S. Highway 101 and Sepulveda Boulevard could transport 200,000 bbl of oil per day. This pipeline would be about 149 km (93 miles) long, would require an estimated capital cost of 112 million dollars, and would have a yearly operating expense of about 27 million dollars. Santa Barbara County has also estimated that an onshore pipeline starting from Las Flores Canyon and terminating at Ventura could transport approximately 175,000 barrels of oil per day supplied in increments into the pipeline. A new pipeline from Las Flores Canyon to La Conchita would meet an existing 56 cm (22 inch) Mobil-Rincon line that extends to Ventura. This new pipeline would be approximately 87 km (54 miles) long, have a capital cost of about 20 million dollars, and have an operating expense 0.4 million dollars per year. Figure III.F.5-1 illustrates the pipeline from Las Flores Canyon to the Los Angeles Basin.

For this evaluation, all Sale No. 48 crude oil that could be tankered and barged from the Santa Barbara Channel would be transported by pipelines. All the crude that could be tankered and barged from Ventura would be transported by the new onshore pipeline from Ventura to the Los Angeles Basin. Also, all the crude that could be tankered and barged from the offshore processing and storage facilities in the Santa Barbara Channel would be transported by a new submarine pipeline to a new onshore processing and storage facility at Las Flores Canyon. This new submarine pipeline would be approximately 29 km (18 miles) long. The

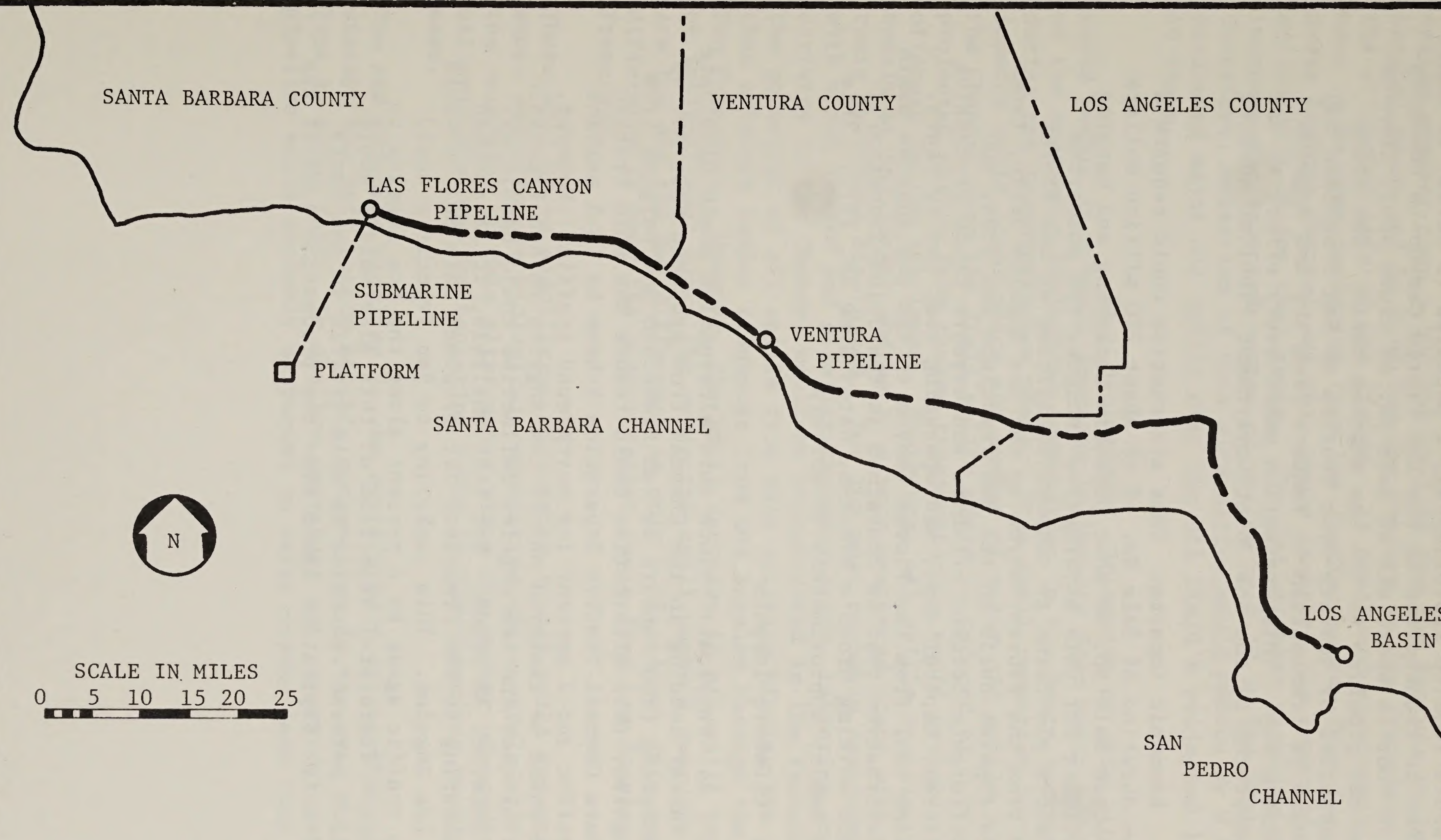


Figure III.F.5-1 Alternative Onshore Pipeline Route from Las Flores Canyon to the Los Angeles Basin.

Source: County of Santa Barbara, Joint Industry/Government Working Group

onshore facility would require approximately 2 hectares (5 acres) of land. The crude would then be transported in the Las Flores Canyon-La Conchita-Ventura pipeline to Ventura where all of Sale No. 48 crude would then be transported by the new pipeline to the Los Angeles Basin. The crude that could be transported by tankers from Ventura to San Francisco Bay for Sale No. 48 would be transported by tankers from the Los Angeles Basin to San Francisco Bay. This evaluation makes every effort to use the information generated by the the Joint/Government Pipeline Working Group.

b. Economic Impacts: This alternative could require a total cost for the duration of Sale No. 48 of about 220 million dollars more than the proposed Sale No. 48 most probable tankering and barging scenario. The estimate for this alternative includes the submarine pipeline from offshore platforms to onshore facilities at Las Flores Canyon, pipelines from Las Flores Canyon to the Los Angeles Basin, tankering from the Los Angeles Basin to the San Francisco Bay area, and assumes no cost difference between offshore and onshore crude processing and storage facilities, capital cost, and operating cost for 19 years. The onshore pipeline cost from Las Flores Canyon to the Los Angeles Basin is based on the information that is contained in the Joint Industry/ Government Pipeline Working Group's Minutes, dated June 16, 1977. This alternative could employ approximately 60 workers.

c. Offshore Impacts

i. Physical: Since this alternative would eliminate all the proposed tanker loading in the Channel from proposed Sale No. 48 and all of the tankering from Ventura to San Francisco and barging from Ventura to Los Angeles, this alternative could reduce the ship traffic in the Santa Barbara Channel Traffic Separation Scheme by 13.5 percent for southbound traffic and 2 percent for northbound traffic. However, some of the crude would be tankered out of Los Angeles to San Francisco since it is doubtful that the Los Angeles refineries could handle all the proposed OCS Sale No. 48 crude. For this analysis, it is assumed that the crude tankering to San Francisco for proposed Sale No. 48 would be tankered from Los Angeles. This tankering to San Francisco would increase the ship traffic again by 2 percent along the Los Angeles to San Francisco route. Therefore, selection of this alternative would result in a net 13.5 percent reduction in ship traffic in the Santa Barbara Channel Traffic Separation Lanes over the production life of the oil fields.

Selection of this alternative would reduce the expected number of oil spills greater than 1,000 bbl by 1.61 for the Ventura to Los Angeles barging route and by 0.65 for the Ventura to San Francisco route over the projected life of the fields. As mentioned previously, there would have to be some tankering from Los Angeles to San Franciso through the Santa Barbara Channel and this would increase the expected number of spills by 1.34 for that route. The new offshore pipeline would also increase the expected number of spills by 0.10 in the Western Channel. Therefore, selection of this alternative would reduce by 0.82 the 3.1 predicted major oil spills over the oil field's projected life of 25 to 40 years.

ii. Biological: Selection of this alternative could result in a small decrease in impacts from major offshore spills on the nearshore biological communities in the Santa Barbara Channel during the transportation phase. This small reduction in oil spill impacts could occur since the number of major oil spills projected for the Channel over the field's life would be reduced by 0.82, and since projected spills from tanker transportation would probably occur further offshore in the sea lanes. Therefore, oil spills reaching shore would remain at sea longer and be in a more weathered state with most of the toxic fractions dissipated. For the most probable development scenario with mixed tanker and pipeline transportation, tankering and barging activity in the Channel would be concentrated in the Ventura area with the potential of oil spills from this activity hitting the coast sooner than offshore tanker transport from Los Angeles through the Channel to San Francisco. However, the small decrease in oil spill impacts should be insignificant since the projected spill numbers over the field's life are low and the net difference is only 0.82. Also, this small net difference is over the entire tanker route from Los Angeles to San Francisco.

There will be no significant difference in oil spill impacts on near-shore and offshore biological communities off central California with the selection of this alternative since the number of predicted major oil spills along the tankering route to San Francisco would be about the same.

The new offshore pipeline in the western part of the Channel would disrupt the soft bottom benthic communities in the area while the pipe-line is being laid. In shallow nearshore and intertidal habitats the pipeline would probably be buried in water depths less than 61 m (200

feet). The pipeline burial operation could damage kelp beds and associated marine communites and disrupt the intertidal communities in the Las Flores Canyon area. These effects should be short term and most of the disrupted communities should recover within a year. Since the California Coastal Zone Commission and the State Lands Commission would regulate the pipeline route ashore, the route should avoid any productive reefs and rocky intertidal areas.

The new offshore pipeline could conflict with the commercial trawling area outside of 3 miles in the northern part of the Santa Barbara Channel. Any obstructions attached to the outside of the smooth pipeline could be a hazard to fishing gear. However, these potential additional conflicts should not be significant.

iii. Social: This alternative would reduce the impacts on esthetics in the Santa Barbara Channel since the offshore processing and storage facility would be eliminated and the tanker traffic in the Channel would be reduced. As mentioned previously, the air quality impacts in the Santa Barbara Channel would be reduced. However, the air quality impacts in the Long Beach area would increase from loading the crude from the onshore pipeline to tankers for shipment to San Francisco.

d. Onshore Impacts

i. Physical: Laying approximately 237 km (147 miles) of onshore pipeline from Las Flores Canyon to Rincon and from Ventura to Los Angeles would temporarily disrupt traffic patterns along the public street route. The onshore processing and storage facility in the Las Flores Canyon area would require 2 hectares (5 acres) of land. Since the California Coastal Zone Commission would approve the siting of this facility, it should be located in an area of minimum impacts. There are several onshore oil storage tanks and oil wells in this area already.

This alternative, by eliminating the loading of crude oil at marine terminals in Ventura, would reduce the total hydrocarbon emissions from onshore loading operations by 1,715 tons per year. The change would decrease loading from an almost continuous operation with 187,000 bbl/day being loaded at a rate of 15,000 bbl/hr. to an intermittent one with 48,000 bbl/day being loaded at a rate of 15,000 bbl/hr. All of this 48,000 bbl/day is associated with non-Sale No. 48 activities. Assuming a 150,000 bbl barge, without the pipeline, there would be 1.25 trips per day, as compared to only 0.32 trips per day with the pipeline. It should be noted, however, that with or without the pipeline only one barge will be loaded at a time. The worst case emissions would not change, but the frequency of worst case occurrences would decrease. The impacts on air quality, as presented in Chapter V, Section F, were estimated for a scenario in which worst case emissions occurred at a time when meteorological conditions favored maximum production of photochemical smog. With the pipeline alternative, the worst case emissions would occur only 1/4 as frequently and would coincide with adverse meteorological conditions much less frequently.

This alternative would also change the location of onshore emissions associated with oil processing from Ventura County to Las Flores Canyon. In addition, the emissions from offshore oil storage in the original scenario would now be located onshore at Las Flores Canyon. Oil processing accounts for 196 tons/year of hydrocarbons and oil storage contributes another 40 tons/year. Both of these are small when compared to the hydrocarbons emitted from tanker and barge loading and are expected to have an immeasurably small effect on oxidant air quality.

The majority of air pollutant emissions associated with marine transport of crude oil arise during the loading of the tanker or barge at the marine terminal. The empty vessel in reality, is full of air that is saturated with hydrocarbon, and this air is vented to the atmosphere as the vessel is filled with crude oil. Additional emissions of nitrogen oxides, TSP, SO_2 and small quantities of hydrocarbons are produced from the loading pumps. Air pollutant emissions associated with the operation of the vessel during transit are small, diffused over a wide area and, generally, have a negligible impact on air quality. The major effect of this alternative pipeline on air emissions will be to eliminate a the emissions from tanker loading of Sale No. 48 crude at a single buoy moor in the Santa Barbara Channel. These emissions are 539 Kg/hr (0.59 tons/hr) during the actual loading operation or 360 tons/year during the peak production year for the project. Production rates are expected to be such that one tanker would be loaded with Dos Cuadras crude every 29 days and a second tanker would be loaded with Wilmington crude every 9.6 days. These emissions would not be eliminated but would be transferred from the Santa Barbara Channel to a marine terminal in the Los Angeles harbor area.

There are other emissions from tanker loading in the Santa Barbara Channel that are not associated with Lease Sale No. 48 and would not necessarily be eliminated by the construction of this pipeline; in fact, these other emissions amount to 1107 tons/year, three times the emissions from Sale No. 48. The impact of Sale No. 48 (Chapter VI, Section F) was estimated for a day when a tanker was being loaded with Sale No. 48 crude but when no other tankers were being loaded in the Santa Barbara Channel with crudes from other oil production activities. The impact of loading three other tankers will continue even without Sale No. 48. The proposed pipeline alternative would reduce the frequency of peak emission days from tanker loading in the Santa Barbara Channel, but it would not totally eliminate the emissions unless tankering associated with tidelands and existing Federal leases was also eliminated in favor of pipeline transport.

ii. Biological: The temporary disruption caused by laying the new onshore pipeline would not significantly affect terrestrial plant or wildlife communities. Most of the route would be along existing rights-of-way along public streets and highways. The California Coastal Zone Commission would be involved in approving the pipeline route and, therefore, the route should avoid any special biological habitats. The onshore processing and storage facility in the Las Flores Canyon area would cause a long-term (25 to 40 years) loss of biological habitat.

iii. Social: The onshore pipeline would cost more to build initially than the available tanker transportation, but the yearly operating costs would be lower. Fewer people would be employed with this onshore pipeline alternative than with the most probable tankering and barging scenario. Employment at the onshore processing and storage plant would be approximately the same as for the offshore plant, except for transportation service.

The complex zoning and rights-of-way permits could take approximately 5 years. Onshore aesthetic impacts around the pipeline rights-of-way would be short term and limited to the pipeline construction phase. The aesthetic impacts of the onshore processing and storage facility would be long term and would exist for the life of the development, or from 25 to 40 years.

c. Summary Conclusions: By transporting all the proposed Sale No. 48 tankered crude from the Santa Barbara Channel by onshore pipeline to the Los Angeles area instead of by tankering and barging to Los Angeles and San Fransciso, the air quality and ship traffic impacts in the Santa Barbara Channel would be significantly reduced. Reduction in net hydrocarbon emissions from this proposal in the peak production year of 1986 could be as much as 1,713 tons per year for the entire Southern California Bight. There would be an estimated 13.5 percent net reduction in ship traffic in the Santa Barbara Traffic Separation Lanes. Reduction in predicted major oil spill impacts would be minor. These reductions would be offset by a significant increase in cost for this alternative ($400 million) and increased air quality impacts in the Long Beach area.

Construction of the pipeline and support facilities would cause minor short-term biological and disturbance impacts along the 236 km (147 miles) onshore route and the 29 km (18 miles) offshore route. The onshore processing and storage facility in the Las Flores Canyon area would cause long-term (25 to 40 years) biological habitat and aesthetic impacts.

6. Pipeline from San Diego to Los Angeles Harbor Area

a. Foregone Development and Foregone Impact Sources: The No. 1 alternate pipeline would be an offshore pipeline that would originate from the platform and follow the coastline to the Los Angeles Harbor. The No. 2 alternate pipeline would be an offshore-onshore pipeline that would originate from the platform and go ashore by submerged pipeline to San Diego. From San Diego the No. 2 onshore pipeline would follow along the coastline to the Los Angeles Harbor area. The No. 1 offshore pipeline would be approximately 100 miles long; No. 2 pipeline, approximately 15 miles of submerged pipelines and 100 miles of onshore pipeline.

According to the most probable development scenario for Sale No. 48, all the produced crude oil in the San Diego area would be transported by barges to the Los Angeles Harbor area for processing. The produced gas would be processed offshore and transported by submerged pipeline to shore. This evaluation will consider no changes to the gas system.

A summary of the comparative evaluation of above three transportation systems is tabulated in Table III.F.6-1. This summary indicates the following: Pipelines cost more than barging; pipelines cause less impacts from hydrocarbon emissions, oil spills, and tanker traffic; and pipelines have less continuous but more one time short-term environmental impacts.

b. Offshore Impacts

i. Physical: As discussed above, Table III.F.6-1 gives the major impacts and changes for the two pipeline transport alternatives considered in this section. The most significant impact reduction would be for air quality impacts for the San Diego area. Selection of one of these alternatives would result in less air quality impacts in the San Diego area from this proposed sale for the transportation phase of development. The risk of oil spills would be reduced, but the predicted greater than 1,000 bbl spills for the entire Dana Point to San Diego area for the most probable development scenario is already a low 0.17 spills over the projected life of the fields (POCS Reference Paper No. 6). 0.17 spills include .05 platform and 0.12 tanker. There would be no barging or tanker traffic from this proposed sale in the San Diego area if this alternative is selected. The offshore processing and storage facility for oil would be eliminated.

Table III.F.6-1

COMPARISON BETWEEN SALE NO. 48 BARGING AND ALTERNATIVE PIPELINES OF CRUDE OIL FROM PLATFORM OFF SAN DIEGO TO LOS ANGELES HARBOR

Transportation Systems	Total Cost[a] Million Dollars	Hydrocarbon Emission at Peak Production Year, 1986[b] Tons/year	Expected Numbers Of Oil Spills Greater Than 1,000 Barrels[c]	Tanker Traffic[c]	Environmental Factors
Sale No. 48 Barging	Pipeline = 6.9 Process & Storage Fac. = 10.0 Total: 16.9	Loading = 110 Unloading = 0 Total: 110	Tanker = 0.12	10,000 barrel barges to and from Los Angeles Harbor	Offshore processing, storage and loading facil-ivity: Navigation hazards and one time seabed disturbance during construction
Alternate No. 1 Offshore Pipeline	Pipeline = 84.0	0	Offshore Pipeline 0.07	0	One time seabed disturbance during pipelaying and pipeline burial near Los Angeles Harbor
Alternate No. 2 Offshore - Onshore Pipeline	Offshore Pipeline = 12.7 Onshore Pipeline = 10.9 Total: 23.6	0	Offshore Pipeline 0.01 Onshore Pipeline 0.00 Total 0.01	0	15 miles of submerged pipeline: One time seabed disturbance during pipe-laying and pipeline burial near shore. Onshore pipeline: One-time disturbance onshore during construction

[a]Order of magnitude cost estimate.
[b]POCS Reference Paper No. V.
[c]POCS Reference Paper No. VI.

ii. Biological: Laying the 100-mile long offshore pipeline for Alternative 1 would temporarily disrupt the bottom communities in an area under the pipeline. The impacts would be insignificant. The pipeline could probably be buried in water depths less than 200 feet as it approached Los Angeles Harbor. The burial operation would temporarily disrupt the soft bottom communities along the pipeline routes. The disruption affects should be short-term and insignificant. A significant impact could result if the pipeline route passed through bottom area highly contaminated with pesticides, DDT, or other pollutants. These pollutants could be resuspended during the burial operation and impact the bottom, fish, and plankton communities in the area. The extent of these effects are unknown.

For Alternative 2, laying the 15 miles of offshore pipeline should have insignificant affects on the bottom communities. During the burial operation when the pipeline comes ashore, the disruption caused by jetting and trenching would have short-term, one-time effects on the shallow subtidal and intertidal habitats. Since the California Coastal Zone Commission and the State Lands Commission would regulate the pipeline route ashore inside of 3 miles from the coast, the route should avoid productive reefs, rocky intertidal areas, and coastal wetlands.

iii. Social: This alternative would reduce the impacts on esthetics in the San Diego area since the offshore processing and loading facility for oil would probably not be required and the barging traffic from this proposed sale in the area would be eliminated. As mentioned previously, the air quality impacts in the area would be significantly reduced for the transportation phase.

c. Onshore Impacts

i. Physical: Alternative 1 would have no significant impacts.

Alternative 2 involving the construction of 100 miles of onshore pipeline for the San Diego area to the Los Angeles area, would temporarily disrupt traffic patterns along the coastal route selected.

ii. Biological: The temporary disruption caused by laying the new onshore pipeline should not significantly affect terrestrial plant or wildlife communities. Any effects would be short term and limited to the pipeline construction phase, since the California Coastal Zone Commission would approve the pipeline route, the route should avoid any special biological habitats.

iii. Social: Both pipeline transportation routes would cost more than the barging option. Alternative 1, the offshore route, would be the most costly. Fewer people would be employed with the pipeline alternatives than with the most probable barging scenario.

The complex zoning and rights-of-way permits for the onshore pipeline Alternative 2 would take several years and would ultimately be resolved by the California Coastal Zone Commission. Department of Defense permission would have to be obtained to cross the large Camp Pendleton Marine Corps Base. Onshore esthetic impact would be short-term and limited to the construction phase.

d. Summary Conclusions: By transporting all the proposed Sale No. 48 crude oil from the San Diego area by onshore or offshore pipeline to the Los Angeles area instead of barging to the Los Angeles area, the air quality, water quality, and ship traffic impacts offshore San Diego would be reduced. The most significant reduction would be the elimination of air quality impacts in the area from the proposed sale for the transportation phase of development. These reductions would be accompanied by a significantly higher cost for the pipeline transportation alternative and short-term, one-time disruptions caused by laying offshore and onshore pipelines.

7. Processing Facilities In San Diego County: Most probable resource estimates for the Dana Point-San Diego area during peak production year (1986) are:

Oil - 2,897 M bbl/yr.
Gas - 4,246 MM cf/yr.

In considering the potential volumes of oil and gas available for processing from this area, gas volumes of 12 Mcf/day could possibly support a gas processing facility. Oil volumes, however, which will be less than 8,000 bbl/day, would probably not justify constructing a partial processing facility onshore or the offshore pipelines associated with it. Justification for a refinery in San Diego County would require considerably more crude (at least 40,000 bbl/day) than the present estimates given for the Dana Point-San Diego area. The only way this could be justified would be to import crude from other areas.

Since gas processing facilities are not dependent on a fixed amount of gas to justify production, the size of a facility may vary considerably. Also, they do not require coastal locations and they can be located in urban or rural areas (depending on existing regulations, etc.). One constraining factor would be the location of pipeline landfalls, since the facility must be located somewhere between the pipeline landfall and commercial transmission lines.

Offshore impacts resulting from this alternative would be the same as those discussed for the San Diego segment in Section III.F.6, Pipeline from San Diego to Los Angeles Harbor Area.

Onshore impacts would also be the same as those discussed in the above referenced section. Additionally, there would be an undetermined amount of land committed to industrial use for the facility (amount of land required would depend on the volume of gas to be processed). Since the California Coastal Zone Management plan stresses that development should occur in existing zoned areas where possible, it is most likely, therefore, that pipelines and facilities would not be located in conflicting use areas (wetlands, recreation areas, etc.). There would be an increase in emissions due to a processing facility and storage tanks, further degrading the air quality. For a detailed discussion of emission rates for processing and storage facilities, see POCS Reference Paper No. V and Section III.D.

Increases in solid waste tonnage and wastewater contaminants would depend on the size of the facility and volume of gas processed. There would be a temporary increase in employment during the construction phase of the facilities as well as the other impacts associated with construction (engine emission from equipment, dust, traffic, noise, etc.). Direct employment as a result of the operation would be insignificant.

Table III.E.7-1 describes the possible emissions from an oil and gas processing plant of 8,000 bbl/d and 12,000 Mcf/d. The impacts, by themselves, are minor but would be significant in a nonattainment area such as San Diego.

TABLE III.F.7-1
EMISSION INVENTORY - ONSHORE OIL AND GAS TREATING FACILITY

Source	Estimated Emissions-Pounds Per Day				
	Hydrocarbon	Hydrogen Sulfide	Sulfur Dioxide	Nitrogen Oxides	Carbon Monoxide
	Continuous Sources				
Oil Facility					
Crude Oil Heaters	--	--	.6	19.8	--
Vent Vapor Incinerator (Includes tank vents for oil and water storage tanks and drain sump vents)	--	--	2.9	.5	--
Gas/Sulfur/LPG Treating Facility					
Tail Gas Incinerator	--	--	50.0	1.6	--
Gas Turbine/Waste Heat Recovery Furnace	--	--	.7	39.3	22.5
Amine-Reboilers	--	--	.5	13.8	--
Sulfur Plant Feed Heater	--	--	.05	.2	--
Converter Gas Reheaters	--	--	.03	.08	--
General					
Minor Process Leaks, (Valve Packing pump seals, sampling, etc.)	4.7	.13	--	--	--
	Non-Continuous (Periodic) Sources				
Standby Boiler (48 Hours/Year)	--	--	negl.	.01	--
Emergency Generator (200 Hours/Year)	--	--	negl.	negl.	.05
Firewater Pump (200 Hours/Year)	--	--	negl.	negl.	negl.
TOTALS-POUNDS PER DAY	4.7	.13	54.6	75.1	22.55

8. Pipeline from Tanner-Cortes Ridge to Ventura South of Santa Cruz Island: The U.S. Geological Survey has discussed an alternate pipeline route from the Tanner-Cortes Ridge to Ventura (Figure III.A.3-1). The alternate pipeline originates from the Tanner-Cortes Ridge, follows the south side of Santa Cruz Island, turns northeast between Santa Cruz and Anacapa Island, and terminates at Ventura. The proposed Sale No. 48 pipeline originates from the Tanner-Cortes Ridge, heads north between Santa Rosa and Santa Cruz Islands, and terminates at Ventura. Both pipelines transport the same amount of crude oil and are approximately of the same diameter and length.

The economics, navigations, hydrocarbon emissions, and number of oil spill impacts should be approximately the same for both pipelines. The impact of deleting the proposed Sale No. 48 pipeline, as described above, is covered in Section VIII.A.3 and 4. This section will, therefore, describe only the area of differences: The oil spill trajectories and the biological impacts.

The change in pipeline routing would alter the oil spill impact on the shoreline segments. Table III.F.8-1 indicates that the probabilities of an oil spill along a pipeline route reaching a certain land segment are different only in the Southern California Bight area. The chances of an oil spill reaching land segments would be slightly less for the alternate pipeline route.

The most significant difference between the impact from this route and the other is on the breeding birds. Although both routes would pass near Scorpian Rock (located near the western edge of Santa Cruz Island), this alternate also approaches Western Anacapa Island. These locations are the only remaining breeding areas of the brown pelican in Southern California. If during construction of the pipeline, vessels came even within several hundred yards of these nesting areas, there is sufficient evidence there would be serious disruption in the nesting habits and reproductive success.

Scorpian rock also is a nesting area for another important species (western gull) and Gull Island, southwest of Santa Cruz Island, is an important nesting area for three more species. Two of these three important areas would be in less danger of being impacted by oil spills or human disruption if the other pipeline route were used.

Purple coral also occurs around Gull Island, very possibly in the path of the pipeline cr near enough to it to be impacted during construction. Pilot whales concentrate off the southern coast of Santa Cruz Island during the winter and the entire area is heavily frequented by other cetaceans. Fisheries are well developed within the path of the proposed pipeline and the temporary interference with their activities during construction and from an oil spill would be largely mitigated.

Impacts mitigated on estuaries, and other endangered species besides brown pelicans and whales would be nill, and the effect on the benthos, intertidal and kelp beds would be essentially the same as described for these resources in Section III.C.

Table III.F.8-1

PROPOSED SALE NO. 48 PIPELINES PROBABILITIES
THAT AN OIL SPILL STARTING AT A PARTICULAR LOCATION
WILL REACH A CERTAIN LAND SEGMENT

DAYS	LOCATIONS	PROPOSED L5	PROPOSED L6	ALTERNATIVE L3	ALTERNATIVE L4
3	Southern California Bight	3 @ 1-36	5 @ 1-45	N	2 @ 1&3
10		7 @ 1-36	7 @ 1-56	N	4 @ 1-4
30		8 @ 1-37	10 @ 1-58	12 @ 1-14	12 @ 1-34
60		11 @ 1-37	11 @ 1-58	13 @ 1-14	11 @ 1-34
3	Baja California	N	N	N	N
10		N	N	N	N
30		N	N	N	N
60		N	N	N	N
3	Tankering Leg	1 @ 1	N	N	N
10		N	N	N	N
30		1 @ 2	2 @ 1-13	1 @ 1	1 @ 2
60		1 @ 2	3 @ 1-4	1 @ 1	1 @ 2

Source: POCS Reference Paper No. VI.

N = Less than 0.5 percent. Example 8 @ 1-37: Spill reaches 8 land segments at probabilities between 1 to 37 percent.

It should be mentioned that the area south of Santa Cruz Island and east of Anacapa Island is relatively pristine and the entire segment of the alternate pipeline around these islands is within a State of California Area of Biological Significant (ASBS). Anacapa Island is a Federal Park Service National Monument.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1979 O - 284-756 (Volume 2)